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MINERAL RESOURCES OF THE PHILIPPINE ISLANDS[1]

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THE Philippine Islands are principally an agricultural country, and their important agricultural exports (sugar, hemp, copra, coconut oil and tobacco) are widely known. However, this American outpost is not lacking in mineral resources. With a few exceptions the exploitation has been confined to the last decade, yet mining is now one of the major industries of the Archipelago. The rise has been next to spectacular and, in value, now ranks second to sugar, which for many years has been considered the premier industry in value of exported products. Hence, mining will probably be given full consideration in any economic planning of the country or any post-war adjustment in the Orient.

In contrast to Philippine agriculture, which received its stimulus largely from the United States, the Philippine government has sponsored the development of the mineral wealth of the islands. Systematic mining operators in this country have relied upon the U. S. Geological Survey, but no comparable agency exists in the Philippines. Their own Bureau of Mines and the National Development Company supervise the mining industry, but an organized survey of reserves is needed. Foreign development of the mineral resources has been restricted, the recent progress having resulted from insular initiative and capital. The American touch is evident, however, inasmuch as American machinery is used and many of the mining engineers are Americans.

Prior to 1907 there was no mention of minerals in the statistical records, and as late as 1932 the "Statistical Handbook of the Philippine Islands" gave only three of the 281 pages to mineral production. The rapid growth can best be realized by referring to Table I.

TABLE I

MINERAL PRODUCTION IN THE PHILIPPINES, 1908–1941

Year	Metallic	Nonmetallic	Total
1908	.....	.....	₱ 460,000[a]
1918	.....	.....	2,600,000
1928	₱ 3,890,860	₱ 15,275,349	19,166,215
1929	6,895,329	8,094,677	14,990,006
1930	7,534,179	8,748,787	16,282,966
1931	7,625,468	8,262,373	15,887,841
1932	10,314,183	10,166,312	20,480,492
1933	16,346,255	5,597,827	21,944,082
1934	11,704,144	4,400,134	16,104,278
1935	16,671,266	4,801,275	21,472,541
1936	25,632,878	5,403,127	31,036,005
1937	55,741,175	6,623,939	62,365,114
1938	72,621,473	6,316,405	78,937,878
1939	78,670,000[b]	.....	.....
1940	90,195,000[b]	.....	.....
1941	79,840,920[c]	.....	.....

[a] One peso (₱) equals $0.50.
[b] Approximate value.
[c] Value of gold production alone.

Of the total mineral production gold ranks far in the lead, but the recent rise

[1] The statistics on mines and mineral production were obtained from the *Philippine Journal of Commerce*, *The Philippine Statistic Review* or the United States Department of Commerce Minerals Yearbook and press releases.

of the base metal industry is significant. Iron ore, which is the most abundant, leads this group, but the ferro-alloy ores of manganese and chromium are very important. The latter probably has the more promising future because of the large reserves and the technological advances which permit low-grade ore, to which the bulk of Philippine reserves belong, to be used in the steel industry as well as for refractory purposes. Copper, lead and zinc are metals of lesser rank, and coal, construction materials and asbestos are non-metals of commercial importance.

Gold Mining

The mining industry of the Philippine Islands is essentially gold mining, for it amounts to more than 80 per cent. of the annual mineral production. Gold mining has been carried on in the islands since time immemorial, for as early as the third century Chinese writings mention gold as one of the principal products of Luzon. With only a few exceptions the 41 producing mines to-day have been worked at some time in the past, abandoned, then rediscovered and reopened. In some cases the present discovery resulted from the presence of ancient workings, whereas in others the current development has uncovered the older workings. Of the many companies organized before 1930, only three have survived.

Gold production means both gold and silver for the two metals usually occur together. By weight the ratio between these two precious metals is about one to one, although there is a wide variance from mine to mine. Some copper and a small amount of lead are also obtained as by-products of gold refining.

The value of gold taken from Philippine deposits was practically nil until World War I, then increased irregularly until the middle thirties. But following the gold rush of 1936 large-scale exploitation has characterized the industry. Technological advances and the rise in price of gold ($35 per ounce) have stimulated prospecting throughout the islands, encouraged the formation of new companies, and induced older establishments to enlarge their plant capacities. Philippine production surpassed that of Alaska in 1935 and now ranks second to California (Table II). Only the Union of South Africa, Canada, the United States and Australia had a larger production than the Philippines in 1941.

TABLE II

Gold Production in the United States and Territories, 1941

	Fine ounces	Per cent. of total	Decrease
California	1,411,800	24	− 3
Philippine Islands	1,109,659	19	*
Alaska	690,649	12	− 9
South Dakota	610,223	11	+ 4
Colorado	377,503	6	+ 3
Nevada	372,300	6	− 3
Utah	347,784	6	− 2
Arizona	315,000	5	+ 7
Montana	246,500	4	− 10
Idaho	150,000	3	+ 2
All others	205,445	4	− 12
Total	5,858,871	100	− 2

* Less than one half of one per cent.

Gold-mining claims have been filed in practically every province, but only eight actually have an operating mine. Active production has been limited to four districts: (1) Mountain Province, Luzon, frequently referred to as the Baguio Mining Region, is the oldest and most important gold-producing area; (2) the province of Camarines Norte, southeastern Luzon; (3) Masbate, an island of the Visayan group; and (4) mountainous Surigao in eastern Mindanao. Of these four, Masbate is the region of older development, ranking first from 1910 to 1920, second from 1921 to 1933 and third since 1934. Mountain Province has been the number one area since 1920 and Camarines Norte has held second position since 1934. Of the 1938 total, Mountain Province, with the first, second, third and fifth producing mines, contributed 63 per cent.; Camarines Norte, 16 per cent.; Masbate, 12 per cent.; Surigao, 5 per cent.; and Bulacan,

PRINCIPAL ISLANDS AND POLITICAL DIVISIONS OF THE PHILIPPINES.

Zamboanga, Camarines Sur and Marinduque the remaining 4 per cent. It is probable that the present order of the four leading districts will continue for some time.

Both placer and lode deposits are worked in the Philippines, but only four of the 41 producing mines are placer operators. These four mines, only one of which is really significant, had a combined production of two and two thirds million pesos, or about 4 per cent. of the total output in 1938. Nineteen mines produce 95 per cent. of the gold, and the four leading mines in Mountain Province supply one half the total. Gold produc-

tion increased every year between 1927 and 1940, and approximately 30,000 men have been employed in the gold-mining industry for the last three years.

Iron Ore

For a long period leading up to the close of 1933, Philippine iron mining was confined to that limited amount which supplied the needs of the local iron industry. This was principally the manufacture, by primitive methods, of cast iron plow shares and plow points for local use.

The Philippine Iron Mines started with a low output in 1934. The following years its output, wholly for export, increased almost forty-fold and 1936 production more than doubled that for 1935. Other companies were organized and, except during 1937, production increased steadily until the recent invasion. Almost all the ore was shipped to Japan, and iron mining probably furnished employment for more than 3,000 persons. By way of comparison, the Philippines, in 1940, mined almost one half as much iron ore as Australia or about as much as was mined in the state of Wisconsin.

TABLE III

Iron Ore Production in the Philippine Islands, 1934–1940

Year	Metric tons
1934	7,239
1935	283,310
1936	654,456
1937	601,190
1938	910,952
1939	1,154,738
1940	1,191,641

The important iron-mining areas are Bulacan, Camarines Norte, Surigao, Samar and Marinduque. Bulacan ores have long been worked in primitive fashion for local use, but reserves are limited and little if any ore has been exported from this region. Camarines Norte has been the leading area of export. The ferrous content of the ore is high, 61 per cent.; but the estimated reserves approximate only five million tons. In contrast the Surigao reserves have been estimated at 500 million tons, one of the larger ore bodies of the world. These lateritic ores are found in the northeastern part of the province of Surigao in beds varying up to nine feet in depth. This area is, in reality, two adjoining beds of ore, low in silica, phosphorus and sulphur, and having an average ore content of about 48 per cent. The deposits are near a good harbor and can be mined with moderate capital and operating cost; but even so, this was the last area to be developed. Little is known about the iron ore of Samar and Marinduque, but these islands have contributed materially to the islands' export of iron ore since 1938.

Chromium

Philippine chromite deposits are of especial interest to the United States because 99 per cent. of the chromium used in this country is imported, most of it, until 1937, from Turkey, Rhodesia and the Union of South Africa. The most important application of chromite ores is in the manufacture of ferrochrome, which in turn is used to make chromium steel for the motor car industry and in alloys with other metals for tool steel and "rustless" steel. The second large consumption of chromite is for lining furnaces in the manufacture of refractories. The latter industry can use a lower quality of ore, and thus far much of the Philippine ore has come under this classification.

It was not until 1935 that chromite production in the Philippines was sufficient to merit inclusion in the trade statistics of the islands. Four years later chromite led in production among the base metals. Exports to the United States began in 1936, and most of the production has been shipped to this country each year. In 1940, a year that set a new all-time high, for we imported approximately one half the world's total production for that year, the Philippines supplied almost one fourth of our chro-

mium imports. In 1939 the Philippines were the fifth ranking producer of crude chrome, only U.S.S.R., Turkey, South Africa and Southern Rhodesia outranking the upstart producer which accounted for 11 per cent. of the world total.

TABLE IV

UNITED STATES IMPORTS OF CRUDE CHROMIUM, 1936–1940
(Long tons)

	Total imports	Imports from P.I.	Per cent. of Philippine production
1936	324,258	4,986	77
1937	533,916	43,648	91
1938	352,085	78,233	90
1939	317,511	71,912	98
1940	657,689	156,566	95

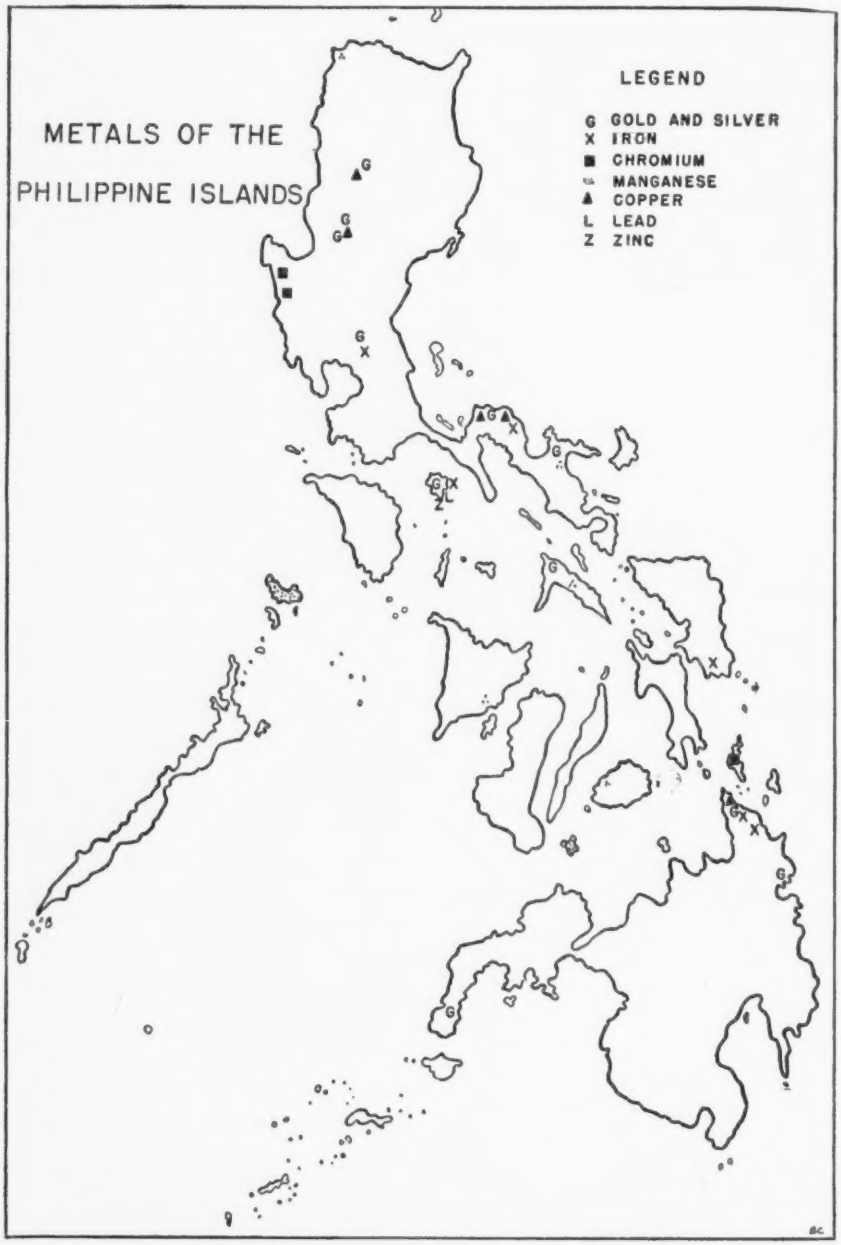
Chromite ore has been mined in Camarines Sur, Zambales and Dinagat Island, a small island a little north of Mindanao. Exportation of ore, more than 55 per cent. chromic oxide content, for Camarines Sur began in 1936, but reserves were limited and have evidently been worked out, for no ore was exported from this province in 1940. The Zambales deposits, believed to be among the largest in the world, contain about 10 million tons of ore. Although discovered in 1933, no production was recorded until two mines began shipments in 1937. A third mine began shipments in 1939 and these three producers supplied 99 per cent. of the 1940 total. The remaining one per cent. was mined on Dinagat Island, but lesser bodies of ore are known to exist on the island of Samar and in Surigao, Mindanao. The largest Zambales mine (79,000 tons) is producing a low grade ore, 34 per cent. chromium oxide, which is used principally in refractories; but the other two (68,000 and 15,000 tons, respectively) are mining ore averaging about 50 per cent. chromium oxide.

MANGANESE

Deposits of manganese ore are known to occur in many parts of the islands, but no comprehensive survey of reserves has been undertaken. In general, Philippine manganese is of medium quality, but it usually occurs in powder form, which is not the most desirable for industrial purposes. Manganese mining does not require highly skilled labor or large expenditures for milling equipment. The ore is taken from shallow, open pits, and much of the mining, washing and selecting of ore is done by women.

The first manganese shipment to the United States was during 1935, although the pioneer company began operations in 1934. It used Philippine labor and capital, but an American superintendent was in charge. During 1938 manganese ores of commercial importance were worked on the islands of Luzon (Camarines Sur and Ilocos Norte), Masbate, Bohol, Panay, Siquijor and Busuanga. By far the principal tonnage has come from the two last-named islands, both of which are small and contain no commercial deposits of any other mineral. Siquijor is south of Cebu and Busuanga lies between Mindoro and Palawan. The latter has the better ore, uniformly over 50 per cent., and four mining companies operate on the island. The Siquijor deposits average 42 per cent manganese and have been mined intermittently since 1937. Production has come from several individual areas, and this island has probably accounted for 40 per cent. of the entire manganese production of the islands. The ore has been shipped to United States, Great Britain and Japan from the ports of Manila, Iloilo, Cebu, Aparri and probably others.

During 1940 Philippine production amounted to 58,038 metric tons, a 61 per cent. gain over 1939 and 40 per cent. more than was produced in continental United States during that year. This ore was 45 to 50 per cent. manganese, which would tend to disprove the general conception that Philippine manganese is of low quality. The above figure compares favorably with the average for Brazil



THE MINERAL PRODUCING AREAS OF THE PHILIPPINES
ARE SCATTERED THROUGHOUT THE ARCHIPELAGO, BUT THE GREATEST DEVELOPMENT HAS BEEN CONCENTRATED ON THE ISLAND OF LUZON.

(38–50 per cent.), India (47–52 per cent.), Russia (41–48 per cent.), and South Africa (30–51 per cent.), the principal producing countries. However, selective mining is practiced in the Philippines, and this is probably not true in the other producing countries. In 1940, 89 per cent. of the ore was shipped

to this country as compared to only 32 per cent. the previous year, the exports to Japan having decreased since 1938, when 98 per cent. of Philippine manganese went to the Land of the Rising Sun. The Philippines, although not a major manganese producer, were surpassed by only nine countries in 1940, and only five of those supplied more ore to the United States.

Philippine manganese producers face several difficulties: (1) a monopoly controlled market; (2) high ocean freight rates; and (3) low to medium quality and high moisture content (10 to 14 per cent.) of the ore. Because of the last-mentioned difficulty, selective mining of most deposits is essential and some washing or screening is necessary to increase the grade. In view of the present world abundance of natural metallurgical ore little has been done along manganese ore beneficiation. A possible solution might be a Philippine ferromanganese plant, using cheap electric power; hence a processing operation near the source instead of at Niagara Falls, where most American plants are located.

Other Metals

Copper, lead and zinc are, next to iron, used in large amounts in modern industry. The United States is self-sufficient in these metals and, therefore, not a favorable market for Philippine output. All three are present in the islands, but their production is still comparatively undeveloped and the quantity of reserves still unknown. Each is produced locally, principally as a by-product of gold and silver mines. The export, then, is partly in the form of ore but mostly as concentrates and unrefined furnace products.

The export of copper was reported for the first time in 1936 and, except for a slump that coincided with the collapse of the Manila stock market in 1937, has continued. In 1938 eight mines produced not less than 30,000 pesos of copper each, but only one reported copper as the principal product. Production for 1939 increased 110 per cent. over that of the preceding year and the output for 1940 was 24 per cent. above that of 1939. The Lepanto and Hixbar mines remained the principal operators, and Japan took most of the 9,259 metric tons produced. United States imports of Philippine Island copper concentrates surpassed two thousand tons.

There is also only one mine, Mineral Resources Mine in Marinduque, that produces lead as its principal product. The 1937 production was valued at 94,389 pesos and increased 141 per cent. in 1938. Exports were sent to the United States and Japan in somewhat equal amounts. Zinc is another product of this company, but its output has been relatively insignificant.

Other metals have been reported and in some cases mined locally but only in relatively insignificant amounts. Included in this group are tin and tungsten from Palawan, molybdenum from Panay (Iloilo), platinum from Mindanao (Agusan and Bukidnon), mica from Ilocos Norte, nickel and mercury. None of these can yet be listed as positive assets of the country.

Non-metals

Production of non-metals in the Philippines was equal to, and in some cases exceeded, the metal production prior to 1933. Since that year non-metallic production has lagged behind until its value was only about 9 per cent. that of the metals in 1938.

Rich deposits of the fuel minerals are lacking. Coal-bearing strata are widely distributed (Batan Island, Cebu, Malangas, Masbate, Mindoro, Polillo Island, Sorsogon, Sugud Bay, Tayabas and Zamboanga) but proven reserves are limited. The coal is described as "too young," and it occurs in thin beds which have been broken by surface movement, thus mining is both dangerous and costly.

Native coal consumption has been supplied largely by one mine on Batan Island in the province of Albay and by small operators in Cebu. Except in scattered and limited localities, Philippine coal is not suitable for coke and is used principally as steam coal. It has been suggested that it might be used for the reduction of metals by non-coke methods or for the extraction of its by-products for chemical raw materials, but since the amount is limited these proposed uses appear improbable. In most respects local coal can not compete in price and quality with coal from Japan and Australia, the two coal exporters in that part of the world. All the mineral oil consumed in the Philippines comes from abroad, 80 per cent. from the United States. Petroleum seeps, residues and natural gas emanations have been found in eight provinces ranging from north central Luzon to central Mindanao, and are usually associated with folded tertiary shales and sandstones. Wildcat operations have been wide-spread, but none has resulted in a producing well. (There is one producing asphalt deposit in northwestern Leyte.) The more promising areas are Bondoc Peninsula, Tayabas and the central plain of Luzon as the formations appear more favorable in those regions. About four years ago the National Development Company engaged the services of several American geologists for a geological survey of possible coal fields and petroleum areas, but their findings have not yet been published.

Other non-metallic minerals have been utilized only limitedly. The cement industry is important, but local gypsum is in the mountainous interior and of the fissure-filling type, so the needs of the cement plants have been supplied from foreign sources. Asbestos has been mined locally in the mountains of Ilocos Norte, Zambales, Pangasinan and Agusan, most of it having been shipped to Japan. Quartz sand from Lubang Island, Mindoro has been used in local bottle-making, and several other silica areas are available. There are sulphur deposits in the many volcanic areas, but known deposits are small and access to them is difficult. Even though deposits exist in several provinces, the supply is considered inadequate to meet the demands of a sulphuric acid plant. Natural fertilizer in the form of guano is plentiful, but is no longer in demand. Evidently this has been supplanted by the importation of chemical fertilizer, 60 per cent. of which comes from the United States. This importation amounted to $1,500,000 in 1938, a decrease of about 40 per cent. over the 1936 figure. Sand and gravel, limestone, marble and pottery clay are available in considerable quantities. Except for road material, some local building construction and cheap stone for riprap, however, these materials are unused.

Mining Regions

From this discussion, four mining regions of the Philippines stand out, and three of them are on the island of Luzon. (1) Mountain Province, Luzon, produces 63 per cent. of the island's gold and is also important for silver and copper; (2) the southeastern peninsula of Luzon and the nearby islands of Masbate and Marinduque have a great variety of minerals, of which gold and silver, iron, copper, lead, manganese and zinc rank in the order named; (3) the mountainous Zambales area yields 99 per cent. of the chromite exports and a little asbestos; and (4) in Eastern Mindanao, especially the province of Surigao, gold and the vast iron reserves rank of foremost significance. These major regions do not include the smaller islands that are important for manganese, chromite or coal or the scattered areas of limited or untested mineral wealth.

ASIATIC SURVIVALS IN INDIAN SONGS

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THE Siberian origin of our northwestern natives can no longer be doubted. Abundant evidence, gathered for the National Museum of Canada in the last twenty years, shows how the Athapascan nomads, after they had crossed Bering Strait into America, spread in various directions over a large part of our continent. Some of their roving bands, following the game, journeyed south along the Rockies, or down the northwest coast, where salmon was plentiful. Many of them scattered over the vast swamps of the far north almost as far as Hudson Bay, while others ascended the Mackenzie into the grasslands of the prairies. Once they had discovered the buffalo, they vied in the hunt with the earlier prairie occupants, eventually displacing some of them with hammer-blows. For they were of the breed of the Tartars. They penetrated as far south as Arizona, and were only prevented by the white man from invading Mexico, as the Aztecs had done a millennium before.

The recent recording of the songs of the northwestern Indians has provided an opportunity for a study of their relationship to Asiatic songs. The results have been startling. Some of the songs, from both sides of Bering, have proved so strikingly akin to each other that an intensive study of our museum collections of phonographic records, with the object of ascertaining whether the songs had a common origin, was bound to follow. Indeed, it is under way, and is likely to continue. A few conclusions, even at this early stage, may be of general interest.

Among Europeans, there is an ample supply of religious and ceremonial songs that are more than a thousand years old, *e.g.*, the Ambrosian music of the Catholic church which adheres to the musical language of the ancients. The innate conservatism displayed in the Ambrosian chants may be observed also in the rituals of other creeds. Songs, in set forms, do not readily change. Handed down from generation to generation, they naturally hark back to the past, sometimes a very remote past. Their tunes and words linger on and on and, often deformed, travel far from their birthplace. Indian ceremonial-songs, in this respect, do not differ from others.

But, curiously enough, the idea of comparing Indian songs with those of Siberia or China as a means of discovering the origin of the former, did not occur to me until recently. Still, plenty of material has been ready at hand for years. Nearly one thousand native songs of British Columbia and Alaska were recorded in the past thirty years for the National Museum of Canada, and many others are conserved in collections of the United States and Germany. Many ancient Chinese and Japanese songs have been marketed by the phonograph companies. Besides, over a hundred Siberian songs were taken down about forty years ago for the Jesup Expedition, and the records have long been stored away at the American Museum of Natural History in New York. They are now in the keeping of Columbia University (Anthropology).

When studying the Indian tribes of the Nass River on the Alaskan border some years ago, I heard on the phonograph a Japanese tune that arrested my attention. It closely resembled some of the songs of the Yukon and northern

British Columbia, which I had been recording among the natives.

The tune at the beginning scaled a high curve, touched a top note, then dropped over wide intervals to the bottom, where it droned leisurely, just as do the tunes of a number of typical Indian songs. The melodic resemblance between the Japanese and Indian songs reminded me of other things: the nearness of Alaska to Japan; the Mongolian features of both natives and Japanese; the fan-like migrations of the Indians away from Bering, which I had been probing; and the cultural stamp of Asia noticeable on the whole northwest coast.

Incessant contacts tended to reunite the related peoples on both sides of Bering, long after they had parted and those on our continent had strayed away to farther districts. Bering is only forty miles wide. It is dotted with islands, freezes over in winter and can be crossed in a day or two. The American and Siberian natives kept in close touch with each other for barter. A trade route extended, since prehistoric times, from Siberia into Alaska, and almost as far as Hudson Bay. The strait was navigated in skinboats during summer, and it could be crossed, over the ice, in winter. No real barrier ever interfered with those widely scattered people, who sought each other seasonally for the exchange of commodities essential to life. Customs and culture passed back and forth also, slowly but surely. There was no complete break.

Ancient traditions accompanied the early migrators in their trek eastward into the Alaskan tundras. It may be easily surmised that, together with other things, some of the ancient songs survived among them, at least in type or melodic pattern. Or else, newer songs might have spread from one end to another along the trade routes. Traders were wont to sing during the barter, to impress would-be purchasers with the excellence of their wares. Asia had much to furnish. She was like a large container overflowing with riches into a still uncultivated and hungry America.

The little Japanese song I heard on the phonograph at the Arrandale cannery of the Nass was enough to remind me of all this. But to what use? To compare Indian customs and songs with those of northeastern Asia is not an easy undertaking, since materials must be secured at first hand.

After having transcribed for publication nearly one hundred British Columbia and Yukon songs, I recently showed about twenty of them to Professor Kiang Kang-hu, an eminent Chinese authority, then on the staff of McGill University at Montreal. The results of his inspection far exceeded my expectation, particularly when we came to dirge or funeral songs. I shall recount here two or three examples of these results.

A funeral song, the Dirge of Raven-drum, is the exclusive family property of Kweenu, a Raven chief of the Kit-winlkul tribe, on the Grease-Trail between the Skeena and the Nass, in northern British Columbia. The ancestors of this family in the recent past migrated down from the north. Their traditional dirges, of which the following is one, were used only at the death of chiefs, and during the incineration of the body on a pyre.

> The Raven drum now has come back. We can hear nothing but its large voice. It is like a great brightness.
>
> The great voice of the Raven, the cawing Raven all covered with pearls, is ahead of me. We can hear nothing but its large voice. . . .

Professor Kiang said that this Indian song quite resembled a Buddhist chant for funeral services, used among the nomads of Mongolia. I had not told him, at the moment, that it was a funeral song of a family of Indians whose home stands in the Canadian Rockies, on the Grease-Trail, running southwards.

His statement led me to look for other significant similarities between the mortuary rituals and songs of Asia and the northwest coast. How startling a turn my comparison would take if the resemblance were to change to identity in such things as ritual forms (in the use, for instance, of similar drums to mark the rhythm), or the appearance of Asiatic words—perhaps Chinese words—in the songs! Buddhism, though in eastern Asia typically Chinese, has traveled far to the north, among the primitive Siberian tribes. It is familiar among the present Siberian tribes of Kamchatka, close to Bering. Who knows but it might have been there early enough to cross the strait with the ancient Siberian ancestors of the present natives of the Canadian Rockies!

The next song examined, the Dirge of the Eagles, was one that is found exclusively in a branch of the Eagle clan of the Kitwanga tribe, in northern British Columbia. This clan partook in the most recent invasion from the north. It has belonged to this district for less than two hundred years.

I looked up to the sky. Daylight came down early from the East.

This funeral chant reminded Professor Kiang "very much" of a Chinese ceremonial song he had heard coffin-carriers sing in the streets of Pekin. So, from Mongolia we had proceeded a step farther into China to find further similarities with Indian songs. But the next song, a second Dirge of the Eagles, brought us a real surprise. The very refrain was the same as that used in Chinese funeral songs.

Alas! alas! alas! alas! . . . (Hayu, hayu . . . .) The chiefs mourn the last survivors of Gyeetanraet. Alas! alas! . . . Now that the great chief has died, it is as if the sun were eclipsed. Alas! alas! . . .

My heart is full of grief, because the burial boxes of the other chiefs (unlike ours) are quite empty. Alas! alas! alas! . . .

The words of the main section of this song were in a local dialect, and referred to a fairly recent tribal event. But, to the singer, the refrain *Hayu, hayu, hayu!* was unintelligible, meaningless.

Not so to Professor Kiang, who was amazed. Hayu means "Alas!" in Chinese, and is exactly what dirge-singers in China are accustomed to exclaim in frequent repetition. It forms an habitual part of familiar Buddhist rituals. The Indians of the northwest coast were unaware that they were singing a Chinese religious refrain. This was indeed a significant and startling discovery.

Looking over a number of other songs, I find that the refrain *Hayu* (alas!), wherever it appears, is used with the right context, *i.e.*, in songs of mourning over the death of a relative, and that, in every instance, it is employed by members of the Eagle and the Wolf clans, both of which were recent invaders from the far north.

The sing-song-like way of moaning because of the death of relatives and friends, familiar among those Indians, suggested other striking resemblances in mortuary customs. While I was at the Arrandale cannery, on the Nass River, close to the Alaska border, during the fishing season of 1928, a tragedy brought grief to the natives stationed there. Several of them died of poisoning, after eating decayed salmon roe. Dirges broke out early one morning, and throughout the following days women could be heard moaning in the woods.

As soon as the news of the misfortune broke out in the summer village, old women began to wail pitifully. Crouching on the ground in front of their houses, they tore their hair and beat the ground with their foreheads. For once in their lives, those Indians cast restraint to the winds and gave vent to grief. Professional mourners, like those of ancient Greece, rent the air with their

lament, and sprinkled ashes on their heads.

"Just as it would happen in China!" Professor Kiang added after I reported the occurrence to him. "There also mourners pound the ground with their foreheads, and they are paid for it. Quite typical!"

From the dirges, quoted above, Professor Kiang and I passed on to others. One of the most striking, because of its strange melody, was *Hano!* (a funeral song belonging to a leading Wolf clan of Gitlarhdamks on the Upper Nass.) Somehow it seemed quite familiar to Professor Kiang, "It sounds very much like a Buddhist chant in a funeral service," he declared. "This chant comes from Hindu music." Another link in the long chain of origins: from Alaska, we pass on to Siberia, to China, to India.

Another Indian dirge of northern British Columbia, that of Small-Raven of Kitwanga, "sounds like a night-watchman's song in Pekin," said Professor Kiang. "The watchman goes out and shouts: 'Be careful of your fire and your doors! Beware of thieves!'" Drum-beats accompany the night-calls. The rhythm of the Indian dirge, Small-Raven (Hlkwaqaq), also is marked by drum-beats.

Hohaleanagwah, I bemoan the small human-like Raven of my sorrowful heart. . . .

The Raven here is the principal emblem of the singer's clan, which passes on to a new holder after the death of the head-chief. The song also includes the words: "I am left alone. Broken-hearted am I when I take his place, for I remember all my ancestors."

Other native songs from British Columbia likewise resemble Asiatic songs. For instance, a lyric tune of the Yukon and the Northwest, often called a "love" or a "mountain" song, "Honekone," was "like a harvest song of China. Girls sing it while working in the fields and picking tea leaves." Like many Asiatic songs, its melody is in the pentatonic scale.

Another, a lullaby of the Nass (that of Nampks) "resembles a Chinese shepherd song. It is very much like it."

A "peace song" of the Haidas and the Nass people, the works of which are in a foreign language not understood by the singers, is reminiscent of "a Chinese sacrificial song." It was learnt by a Nass River Indian, the old singer's father, from Haida Indians on Queen Charlotte Islands. The Nass people had fought the Haidas long before, and peace had been restored after prolonged enmity. Nine canoes of the Nass tribes went to Tlawaq, on an island, and a feast was held. The Haida chief sang the peace-song during the ceremony. The guests from the coast of the mainland stayed there for three weeks and learned some of the songs of their hosts. After that time the Haidas and Nass people intermarried. The learning of the "peace song" by the singer's father shows how songs often travel from tribe to tribe. Many Nass River songs are in foreign languages, mostly those of northern tribes.

A lyric melody of the uplands, the "Fireweed" song of the Skeena headwaters, resembles a "Chinese street-tune." Its first part certainly sounds exotic, almost European, if heard among other Indian songs.

The Fireweed people will drink fermented juice with the Wolf and the Raven tribes. Why think you that we know not how to brew it? We walk about proudly, because we have made it for a long time.

Another song, a lullaby, reminds Professor Kiang of a Japanese lullaby, to the accompaniment of which Nipponese mothers, and Indian mothers also, gently sway the children wrapped upon their shoulders.

The use of the drum in the Indian

songs is an important element to consider in tracing their origin. The Indian drum of Alaska and the Canadian Rockies consists of a tanned skin dried and stretched over only one side of a closed circular band of wood. It is exactly similar to the instrument which the Koriak tribes of northeastern Siberia use in funeral rituals. Siberian drums, according to Jochelson,[1] are "covered on both sides with hide, like those found among the American Indians. . . . Together with drums covered on but one side" they "are used in Siberia only by the Buddhists," in "their divine services." Even in size the Siberian and Alaskan skin-drums are much alike, as our photographs show. In northwestern America, the drums were used not only in "divine services" but in rituals of incineration. For dead bodies, as in Siberia, were burnt on a pyre surrounded by dirge-singers and mourners.

In the light of these discoveries, a new field for investigations lies open before us. Theorists for many years have endeavored to explain the independent origin in America of cultural features known elsewhere. Primitive men were supposed to find within themselves the faculty of recreating the same processes over and over again wherever they might chance to be. For lack of historical records, it was impossible to check the application of the theory to features that refused to reveal their origins to investigators, and were accordingly swamped under a deluge of vague, if not sentimental, assumptions. But things may now take another turn, should the comparison of native songs on both sides of Bering prove that they go back to common Asiatic sources.

The new evidence under observation may turn out to be of a historical nature, should it be finally established that an early derivative form of Buddhism long prevailed, as now seems practically certain, in the mortuary rituals of the northwest-coast Indians. Things like Buddhism and the Chinese mortuary rituals can not be considered essential to human nature. They are a culture growth, largely accidental, like all other such growths. Besides, there is explicit evidence of the migrations from Asia of the people themselves.

Once this is generally taken into account, many other so-called independent creations of prehistoric America are bound to prove derivations. Professor Kiang, impelled by the new drift of things, is already working upon a series of striking similarities, if not identities, between Mexican and Chinese civilizations. His work may be the beginning of the end for native American "insularity" in culture.

A thorough analysis of northwestern American and Siberian songs and rituals is an unavoidable step in the right direction. It is fortunate that it is now being undertaken. Over a hundred wax records of Siberian songs have been preserved, unpublished, for about forty years at the American Museum of Natural History in New York. They were recorded for the Jesup North Pacific Expedition to the Northwest Coast and Siberia. Their usefulness in the present investigation can hardly be exaggerated. I was startled, when I studied them early in January, 1933, with the definite evidence they yielded in a number of unforeseen directions. What was only conjecture without them, now becomes something demonstrable. Unexpected relations, of a semi-historical nature, are brought out between people on both sides of Bering—some of them far removed from each other—such as we had not even thought of before.

[1] "The Jesup North Pacific Expedition," IV.

AN ANTHROPOLOGIST IN RUSSIA. II

By Dr. A. HRDLIČKA

CURATOR OF PHYSICAL ANTHROPOLOGY, U. S. NATIONAL MUSEUM

A row of wagons tied to each other—the drivers sitting together on the last one for sociability regardless of the dust, talking, and the good little shaggy horses going it slowly alone. Have learned to love the Russian horse; he is not much to look at, but evidently has strength and sense and individuality.

A group of brownish Kirghiz at work on the tracks—try again in vain at stations to get postals with their pictures.

Sky still overcast, but no more chilliness, just agreeable warmth and the sun trying to break through. The train is most comfortable and one gladly forgives that it is not so very speedy. For second and first class such excellent trains are nowhere else in Europe, and but few in the West, in our own country.

The first rodent holes. Have not seen any at all before on this journey, nor any hares, rabbits, partridge, quail or other game. Only black crows, and the black-and-gray jackdaws. The wild flowers have changed again somewhat, some of them would look good in a garden; the wild-parsley-like plant is gone, but the daisy has reappeared, though not in large quantities. Here the Trans-Siberian is already double-tracked, or being so made—had it been so before the Russo-Japanese war the results might have been very different. . . .

And now, as we near Taiga, the ground becomes definitely more uneven, at first only long depressions and low ridges, later little irregular hills—though no stones yet. And not one tenth, perhaps not one twentieth, of this fine ground as yet utilized. A propitious region, waiting for man. The thick grass and weeds show it is fertile and even in part well watered.

First swallows, first magpies. Once in a while a wagon, a hut or a red skirt or kerchief in the landscape.

Two real big cities, Omsk last night and Novo-Nicolaievsk this morning. The larger Siberian towns so far are, however, like repetitions of one and the same, all situated on a low rise to the east of a big river, while low grounds stretch towards the west; and also in composition—a number of churches with their bright-colored domes, some larger brick structures, a few brick and cement houses, and the great rest all small log- or frame-dwellings, each with its little barn and chicken coop and a yard-garden, set along wide, long, straight streets mostly green with grass. At Omsk hundreds of cows seen browsing along these streets—each family has one or two. They were sent out to pasture over the day, and were now returning to be milked. . . .

Immigrants are seen at every station and in their trains often strong, grizzly, shaggy figures; and placards at stations announce that "in the Primorskaia gubernia there are still 81,000 freeholds for distribution, in the Zabaikalskaia over 60,000," etc. Saw similar trains in my former visit to Russia, and pass one or more every day of this journey. The migrants are mostly whole families, with all their belongings tied up in bags; occasionally they even bring grain or flour. They are steadily peopling Siberia, and there could scarcely be a better stock for that purpose. . . .

The journey is nearing its end—at 7 to-morrow morning will be at Krasnoyarsk, and then the real doings will begin. Wish I knew the language as a native so I could pass freely and understand everything, and then to have sufficient time to see all of importance.

May yet give up the return by Europe, for here I am at the mine of knowledge and here is the true workshop for me. Want to reach the human sources here, for every glimpse of the natives makes me feel more and more strongly that near here somewhere must also have been the sources of the American aborigines. . . .

The day ends in country every part of which is interesting. A huge empire of fifty years hence. No winter will keep people from such lands, and who knows what lies beneath them? How different this from the Siberia of one's preconceptions!

July 19. On the Yenisei River. Bound for Minusinsk, on a wood-burning small old-fashioned river boat—three and a half days' journey. On the fine, beautiful, great Yenisei, of which the natives sing. My presence here almost like a dream, and by forgetting a little the surroundings and the absence of man's evidence it would be like on the Hudson where this passes above West Point through the lower hills.

Yesterday awoke amidst green moderate elevations and depressions, and soon after that the train reached Krasnoyarsk —a fairly big village-town stretched over a low flat terrace, on the left bank of the great stream—a terrace about four miles in length and formed once by the river. The place is really just a great village which here and there begins to turn into a city. Went with the engineer friend and put up at a frame hotel with big rooms, good possibilities, but furnished without taste and neglected like some of the frontier places in our country. There are two other hotels in town, one better but dear, the other, judging from outside, worse than this. . . .

The day was warm and I spent it in going about trying to find people, see Museum, get tickets for boat, visit the lunch-room. By ten at night, after many miles of walking and with feet almost sore in the heavy shoes, have seen everybody I wanted and was ready to go to sleep—but not so other people in the hotel, who kept going about, talking, etc., I do not know how long. Had I not done such a day's work I surely would have had but little sleep, but as it was rested anyway, noise or no noise. In the morning, however, everything was asleep—at 8:30 not even a little coffee ready. Asked for my bill—"the paper was locked in." As I could not wait, the domestic, the only one about, began to write it on a half torn sheet with some advertisement on the other side and began to put down, as usual here, candles, which I never used, bed-clothes, to which I objected, and of course the room. With the help of my friend, who fortunately just appeared, succeeded in reducing the bill to what was reasonable and in having it written on a decent piece of paper. . . . Such places have I presume but common demands, the owners are not rich, and they have no experience of better conditions. They will disappear in the natural course of things.

At 9:15 on the boat, a sort of a ferry about 120 feet long. Could get no more of the very limited first- or second-class accommodations yesterday, so took a whole "cabin" third—fortunate that such was obtainable. As it is shall be more comfortable than I would have been in the second or first class with one to three companions; only there is no water to wash with in the cabin. The center of the boat, a good-sized space, is filled with the "muzhiks," their wives, children, bags, boxes, etc. The only provisions for these people are numerous flat benches, standing so that barely enough space is left for approach to the cabins—or more fitly "closets." On these benches they soon have their "padushky" (pillows), and blankets of all sorts, and before long a good many are lying down and sleeping, men, women, children, side by side, in all positions, packed almost like sardines. But still more come later on, stepping over and among those already on the floor, looking for a bit of space

for themselves; yet there is no altercation, no disorder, no sign of any distress—all seem to have plenty to eat—there is no drink, except some "kvas" (weakly alcoholic nourishing drink made by fermenting stale black bread)—and all appear contented.

The day is hazy, somewhat cloudy, but luminous, warm. My cabin measures $4' \times 6'$, is $9'$ in height, and has a window from which I can look westward. The only furniture is a little table-shelf in the free corner, a wooden bench for a lower and a plank for an upper berth, and on my bench a grass-filled mattress with a clean unbleached linen cover; also little folding carpet chair, and a small rack on opposite wall for hand baggage. If there was another passenger it surely would be close but as it is it suffices, and I like the simplicity, the more so as all is quite clean and without any traces of insects.

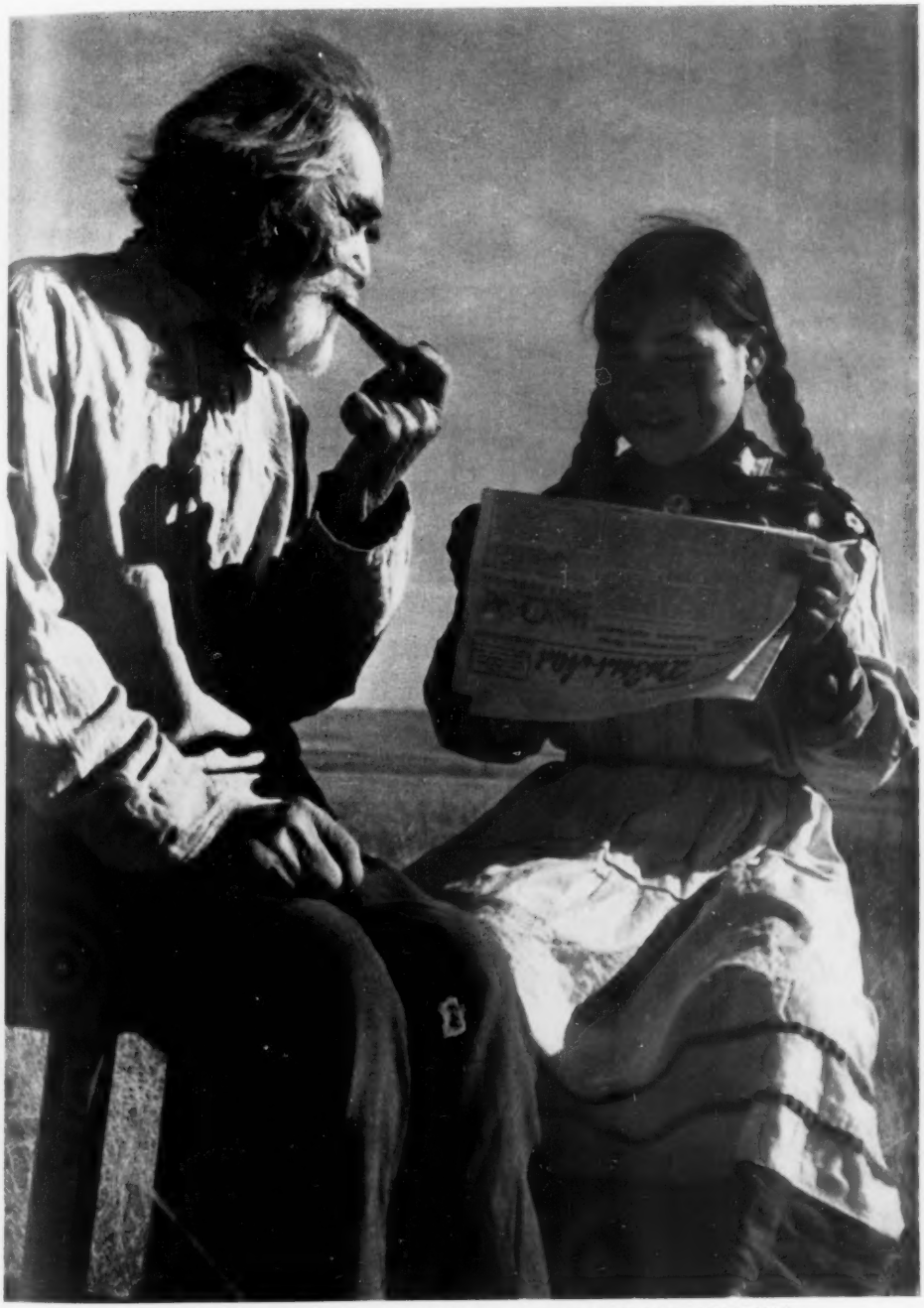
Some wait before departure. As I had no breakfast yet, the first thing I do is to order "chai" (tea), and they bring it to me in a little pot which sits over a larger pot of hot water. One can drink the tea, which is good but not strong, and then add water and drink again, and so on to many editions; and that is the way the people here do it.

Make an acquaintance—a doctor and amateur naturalist from Tomsk; but he speaks the Russian so much worse than others, and is so much less apt at understanding what I say, that to be with him is more of labor than pleasure. However, much better than no one.

Go to top deck or rather roof. There are a number of benches along the sides and I take the foremost, where I leave everybody behind. The air is peaceful and pleasant. The fine, mighty Yenisei, as broad here as the Hudson at New York, with fresh-green islands, stretches before us to the steel railroad bridge and thence into the hills. On the left, the east, rises a continued range of high green hills with spruce woods, and there are in spots lanes of brown-black freshly tilled soil and green lanes of grain fields on the slopes. To the right on a long bench about sixty feet high above the present level of the river is the village city, and farther on as well as behind mount finely green hills. There are as yet no quays here, no docks, only the natural shore of gravel. Boys are fishing from this, and once in a long while get a little silvery fish about three inches long. A man and again a girl come to the river and drink with their hands, regardless of impurities—but there are as yet no sewers opening here and so there is no special danger. The town, which has nearly sixty thousand inhabitants, has no sewers yet, as it has no car line and so many other things. A short distance from the floating boat wharf is a raft, very simple, for the washer-women, and it is full. They beat the tougher wash with wooden ladles as in old southern Europe and use no soap, but the water here is very soft. A soldier bathes a horse, farther on are two small bathing houses for men and women, and some clumsy rowboats made on the style of single log dugouts, which doubtless were their prototypes. What a chance here for a first-class bathing place and an array of nice rowboats, little sailboats, launches of our kind. But there are plainly so many chances in Siberia. . . .

A ferry swings across the broad stream by an ingenious device without any power of its own. It is tied to a line which is fastened also to half a dozen of boats, the first of which is firmly anchored in the middle of the stream, the others stretching along the line at a distance from each other; and this arrangement, which sustains the long tow-line above the water, together with the current and the rudder, carries the ferry whenever needed between the town and an island, perhaps a thousand feet distant.

Our boat starts a little after 10 A.M. It runs well, only slow. It pulls a



A YOUNG COLLECTIVE FARMER OF KHAKASSIA, SIBERIA
READING A KHAKASS NEWSPAPER TO A NINETY YEAR-OLD FRIEND.

SPASKA BRAVA—THE MAIN TOWER AND ENTRANCE OF THE KREMLIN
WHICH FACES THE RED SQUARE AND IS SLIGHTLY BELOW THE CATHEDRAL OF ST. BASIL. ALONG THE WALL TO THE RIGHT ARE BURIED MANY OF THE VICTIMS OF THE REVOLUTION. THERE, ALSO, IS THE TOMB OF LENIN, FROM THE TOP OF WHICH STALIN AND THE REST OF THE MEMBERS OF THE SOVIET GOVERNMENT REVIEW ARMY AND PHYSICAL CULTURE PARADES.

freight barge and will stop at every landing along the river. A fairly stiff breeze now blowing on the water, but the temperature is agreeable. Pass under the R. R. bridge, a huge iron structure, and on the east shore take on a lot more passengers. I thought the boat was already full, but there came probably forty others, and with what baggage! Boxes, small trunks, bags, an odd wheel for a wagon, sled-runners, bread tub and other things; yet they all get in somehow or other and that without disorder, and take their places on the ground and in all corners. They are not allowed to bring their things onto the top deck or that too would be turned into a "lager," but otherwise they can go wherever they want; there are no restrictions.

Pass picturesque rafts with wood, and later others with piled-up sacks of flour, or with hay, even with a load of cows and horses. Two men, or four, occasionally a woman among them, with big heavy oars, work alternately now in front and now behind, two at one oar. There is a dog, a sheltered bench to sleep on and a pile of sand on the top of which is kept fire—people and a life of their own, as on all big rivers.

We stop near one such raft fastened to the shore, and one of our muzhiks or "chelovieks" (a human being), as they call them here, commences at once to inquire of the man on the raft where from, and how much does bran sell at his place, and how is the "chleb" (grain) there this season. Pity I can not yet follow everything. It is provoking to see a child of four or five talking the language so well and here I can not. And then come almost angry thoughts as to when shall the people of the world be evolved enough to adopt but one language, carry it to perfection and get rid of this and many other serious barriers to human progress. But that will be near the millennium, not in our time, and meanwhile half of man's life and effort must be spent in struggling against im-

pediments which he is unable as yet to overcome. He is still a victim of his defects and the mastering of these is so slow, so very slow and difficult. . . .

Notice that on shore most of the people wear black gauze about their heads and necks—this am told not so much against mosquitoes as against swarms of little flies and gnats.

It has now become rather windy on the river but not unbearable, and I keep my seat. Accidentally come across a newspaper notice that "there has arrived, at Krasnoyarsk, the Director of the Psychological-Anthropological Museum at Washington, Prof. Ales Gerlin" —which, it dawns on me, must mean myself. They have no H in their language, and the rest was just massacred. . . .

From what I see of the people, but few even here are of the more southern Slav type. Nearly all grizzly, in all shades, and the heads and faces rather oblong than rounded. They work very well and rest very thoroughly; and eat and eat, when they have. Women smoke cigare'ts which they make themselves, as do the men, but both moderately. Many pitted from smallpox, but nearly all have good sets of teeth, and one sees no weaklings or deformities. Marks of poverty, but not as repugnant as elsewhere; and have seen yet no beggars here. . . .

The river is growing in beauty, the hills and slopes on both sides are live green and very pleasing. All is as fresh as new. My friend, the naturalist from Tomsk, comes and tells me enthusiastically of a wonderful discovery of his at Tomsk—a new frog. Lived there fifteen years, searching for amphibia, etc., but always went out one way from the town. Then once he thought he would go the other way. So went and, in returning towards evening, heard in a swamp a peculiar something with a very strong voice, which he took at first for a bird. On closer investigation, however, found the sound to proceed from the edge of the marsh, so approached carefully, located the sound, and pounced on the animal, taking it regardless of wetting—and found a new species of a big bullfrog, related to the American. And all told so delightfully naively. . . .

THE BOLSHOI THEATER OF MOSCOW

WHICH WAS DAMAGED BY THE GERMANS IN THE RECENT SIEGE OF THAT CITY.

The Yenisei water here is just a little muddy, of much the same color and swiftness as the Potomac when there were no heavy rains; and the bed has now become somewhat narrower. There are low flats covered with sapling birches; there are cliffs and slopes from which brownish rocks protrude like the ruins of walls or towers; there are woods and greens where the eye involuntarily looks for deer or a bear perhaps; and only once in a very long while is there any sign of human beings.

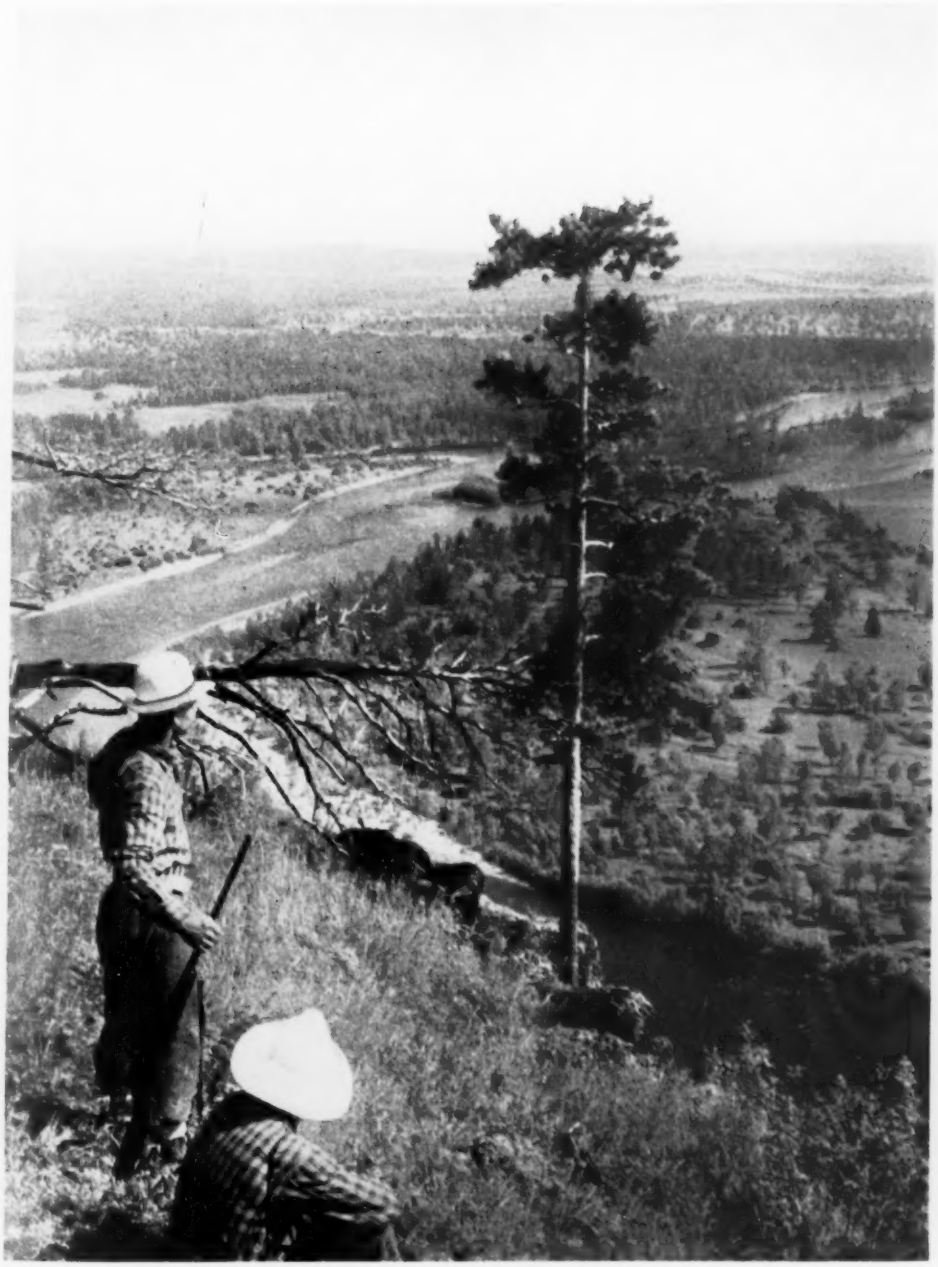
"Dinner" from 1 to 5, and nothing after that except to order. Good "borsheh" or red cabbage soup with a hard-boiled egg, a piece of meat and sour cream, all in one, very nourishing and by no means disagreeable; a fine piece of fresh sturgeon, good rye bread and the inevitable tea. Am able to save a good portion for supper, as do others.

Rocky cliffs to right with dark caverns. And a little later a "dierevna" (village), exactly like those in Russia. Plenty of children, an abundance of them everywhere. A group of men and women in a birch thicket on shore sing to us as we pass, agreeably, "to make us feel good." There are some wooden huts built into the shore, front of logs, roof earth and sod. A smaller affluent from the left—scenery now as primitive as that in the Sierras in Mexico. On right high steep rocky slopes continue. Meet a little boat with a square dark sail—does not look very trustworthy. A low sandy bluff with hundreds of holes in it—homes of swallows. And at the upper end of the bank, in a gully, a small stream and a log-house with a primitive mill.

Now we near a lone church with two nice blue-green bulging little domes, in the birch forest on the left, and a small chapel not far from the shore. It is a pilgrim place, where the travelers of the river may linger a little in the peace and beauty of it all, and say a prayer. As we come nearer the church bell gives a few sounds, some of the pravoslavny priests with curious hats and long hair are coming down from the church to the chapel, one with a collection box takes his place at the steps which lead onto the small low flat from the river, and our boat sides into the raft which is rigged up here for the landing. The boatmen call "half-an-hour's stop." The chapel is opened, about three fourths of those from the boat go in, buy and light candles, hear some charmingly sung litanies in the characteristic deep Russian voices, then gather daisies on the greens about and stragglingly return. The priests now take a position on the bank and as the boat departs sing a final lovely majestic choral, and bless all with a large metal cross. I too went and listened, and felt good, and brought a daisy. How beautiful all this was, thus far out of the world. Submission under such an enchanting form bears something deeply instinctive and happy, and is proper to man, who is so dependent on the great known and the still far greater unknown. Priests served, pilgrims prayed, and all were chastened and strengthened. So, stranger, do not belittle, do not begrudge, but partake fully and give freely, and you too will be consoled. Could only all chapels, and priests, be such. . . .

The cliffs to the right now show rock broken up in vertical seams. And as we pass on we come, 50 versts above Krasnoyarsk, on the right shore, to limestone bluffs full of large deep caves, the "Birusi" caverns—a highly promising spot for exploration. There are but two small primitive limekilns around, and as most of the caves look inaccessible they presumably have not yet been despoiled. (Had one of them explored later by a friend from Warsaw.)

As the cave-cliffs are passed twilight is on. Have my little supper, with lots of weak tea. Engage in some conversation or rather listen to some with now and then a question, about Minusinsk. That is said to be a town of about sixteen thousand, and if the hotel at Krasno-



THE VALLEY OF THE UDA RIVER IN EASTERN SIBERIA

THIS IS ONE OF THE MOST POPULAR VACATION REGIONS FOR SOVIET TOURISTS AND ALPINISTS.

OLD-FASHIONED RUSSIAN FARMER

RUSSIAN GIRL FROM UKRANIA
TEEMING WITH HEALTH AND GOOD NATURE.

yarsk was bad that at Minusinsk is, I am assured, worse. Well, need not be there forever. . . .

When I come to my little cabin and ask the boy about bed, the pillow, sheets, cover—am told there are none and I ought to have brought my own. However, after some ado the boy lends me his own pillow, hunts up somewhere a clean case for it, sells me for two rubles a new sheet of good unbleached linen, and I go to sleep. But the cover is too small; so it occurs to me that I have a piece of red cloth with me which I carry for a background in photography. It is just large enough and so, by about 11 or half past, after chasing some fleas, fall sweetly asleep. Had a day to a satisfaction.

About 1 A.M. am aroused by unearthly noises of wood thrown on board, and this keeps up for an hour. They are loading the boat with fuel, bringing a pile after pile of the big splits on two poles and throwing them on the floor about the boiler. That no one can sleep with such a noise is evidently quite equanimous to those who conduct this, for they make not the least effort to diminish the crashes, and pay no attention to any one. Well, the only thing to do is to console oneself that nothing lasts eternally. It did stop at last, and then I slept with vengeance till half past seven. . . .

July 29. To-day, Saturday, the scenery has changed, the hills are lower, less green and less beautiful, the exposures of the rock show horizontal stratification, and camps of gold-washers have begun. The country is growing more populated, several small villages are passed, located as a rule on the flat banks of the river. Stop here and there, women bring milk, five kopecks (2½ cents) a quart or a liter bottle; black bread, ten kopecks a round loaf of three to four pounds weight; eggs; some of the half-ripe nevertheless sweetish strawber-

ries, currants; very thick sour cream in earthen jars; and even a piece of butter. Then a man brings a pail of kvas, the fermented sourish not unpleasant drink made from stale black bread, and sells a kopeck a drink, that is a ladle. Everything is bought by the passengers, the milk especially, though not without much effort to reduce the price a kopeck or two on the part of the buyers. But all goes on good-naturedly and all are satisfied in the end, except one or two stingy ones who wanted the bread another kopeck cheaper so long till all was gone and they were left without any. But the others will surely sell them a portion. Have not seen such a bargaining since somewhere in the Old World in my boyhood. . . .

The meals are as yesterday. No one comes to do my bed, so I do it myself; it takes but little exertion. Look for the bothersome fleas, but they are not to be seen; anyway they do not yet bite me, just run and jump over the body. . . .

At 3 P.M. another stop of an hour for loading wood—they seem to want enough for the rest of the journey. All go picking strawberries, I also—they are small and not many, but good. Some of the muzhiks buy a live sturgeon, in a minute have an iron pot over a fire on the beach and the fish is cooking, while they form a brotherly group about and wait for their supper. No one minds me or stares at me. If only I could speak their language properly, some of them seem full of knowledge and love of these regions.

The river now meanders and divides between flats and among low islands, the hills in the background coming but here and there to one or the other bank as if to take a look at the stream. The day is warm but bearable, the sky keeps hazy.

The second night passed better than the first, one stop only at midnight; the noise of the anchor awoke me, but there was no loading. Am quite comfortable under my "compound" bedding, and with the fresh air, enough to eat and plenty to learn, see and think of, am very contented. . . .

The hills have changed, show reddish dark or light green sides, gulleys, corrugations, and are now barren of trees or only sparsely and partly covered. The rich alluvial flats and islands along and in the river just cry for the plough, or at least the scythe, or cattle, but their time has not yet arrived. . . .

Needed to shave, but there was no looking glass and I was unable to improvise any; so called again on the boy, my efficient provider, and he brought me a fragment of one, about 4 inches long by 2 broad; I stuck it behind a card with rules on the wall, and all went fine. The simple life for "sarten."

LAKE BAIKAL IN SIBERIA

As I came out from my cabin saw a muzhik who had just washed his whiskered face in a pail of the river water and was wiping it slowly with his coat. Then saw a deck-hand who also washed, but following just shook the water off like a big dog and left the rest to dry.

The boat itself is kept clean and free

from smells and is in general very well managed. Met another such going down the stream named "Sokol" (ours is "Nicolai")—like a friendly neighbor—exchanged greetings. . . .

The weather is again fairly warm and the sky hazy, clouded. The river is still quite large, and in places swift. Curiously there are no water-fowl—but that is probably because of the season. There are also no fish jumping and no one at our stops now tries to fish, nor are there any nets or fishing boats to be seen, so the water here at this time of the year is probably not rich in fish. Also have seen as yet no trace of mollusks of any kind. And there is no smell to the yellowish-greenish and nearly clear water, such as given off by the Potomac and other rivers. . . .

The Sunday passes on mildly and, as usual, one would not know it except by the calendar. There are the same stops and loadings of wood, the same good-natured marketings and bargainings for one, two, three kopecks as on other days, and there are no Sunday costumes or observances. The hills now grow again higher but nuder, and we are slowly coming to a drier region. Great flats made formerly by the river, and similar islands, lie unutilized—the best earth and easy of irrigation, if needed, but not yet needed enough. . . .

It is now windy and cooler, the muzhiks have put on their overcoats—we are getting higher and nearer the great southern mountains. There is a good deal of humor in these homely men and women on board, but they are never noisy. Drink, strangely, is almost absent. Have seen just two bottles of beer on this whole journey, and there has not yet been the slightest quarrel or disorder.

My friend of the frog fame makes me acquainted with two or three other passengers. One this evening. Used to be a soldier at Kronstadt and now in the service of the steamboat company. Was glad to answer all I could ask—I do not dare yet speak very much—and then went on telling me and telling me, of

A POSTMAN HANDING MAIL TO A YOUNG COLLECTIVE FARMER

ELEVEN NEWSPAPERS ARE PUBLISHED IN KHAKASSIA. POSTMEN DAILY DELIVER LETTERS AND NEWSPAPERS TO THE REMOTEST CORNERS OF THE LAND.

what I shall never fully know, but it was some part of the universal complaint against the government and especially the officials. One can not approach closely any one without soon hearing some of the same story. But I was glad he talked, for what still sounds largely like the bubbling of a brook little by little is becoming more intelligible. I would like so much to know well this expressive and, when spoken well, especially by a fine woman, a really beautiful language. Have accidentally heard two such on the river promenade at Krasnoyarsk, and followed them as close as I dared just for the treat of it. They were young, but I never even saw fully their faces. . . .

It is now nearing 10 P.M.—near noon in Washington, almost at antipodes. The last night on the boat—where and how will I sleep to-morrow? But what matters? Am clean and well, have made a journey of near 500 versts on one of the great Siberian rivers, and there is a whole new creation before me where I go. . . .

Have come now into a region of semi-arid plains and mountains, and into one of old burial places. The latter are marked with more or less high and upright stone slabs, which we see in some places from the boat. The captain says that on clear days one can already see from here the snow-clad peaks of Mongolia; but it is again hazy and half-cloudy. On the west they point out to us coal mines, said to contain millions of tons of good coal; and farther south, the engineer tells me, is a mountain of asbestos, large deposits of marble, and other native riches, waiting till Siberia gets ready. . . .

July 21. Had another wood loading at 1 A.M. with the usual results, but now, there being no more wood, they keep on; at 2 P.M. are to arrive at Minusinsk. Will see the Museum, natives and the old burial grounds of the region. . . .

Now that this little idyllic journey is nearing its end I become conscious that I shall be sorry to part with all this company which has become a sort of a big family. Yesterday a nice, middle-aged, well-educated lady began to talk to me, and before the evening we were like old friends. She told me much about hers and wanted to know of mine, and it was all so kindly and genuine, ending with cordial invitations to visit her Tobolsk family. . . .

Minusinsk is the southernmost town in these parts of Siberia. It lies in a vast alluvial grassy plain beyond which looms a chain of forbidding snow-clad mountains, the Sayan range of western Mongolia. It is a nice, not very compact frontier city, and surprised me by its astonishingly rich and well-arranged Museum. The vast plains about it with their rich soil will once be a region "of milk and honey." But they are interesting also in other ways. Disseminated over them, especially in the northwestern direction, towards Atchinsk, are hundreds of old native "kladbishche" or cemeteries, marked by their more or less leaning tall stone-slab monuments. They date from the bronze to early historic periods and contain the remains of countless nomads whose flocks and occasionally armies roamed over these plains. It was from these regions doubtless that Genghis Khan recruited much of his strength. Remnants of the old population still live on the Abakan River, where I went to see them and where with the aid of a young Russian I obtained many photographs; and the whole country is full of promise archeologically. . . .

The few days spent in the district passed rapidly, were followed by a much quicker return to Krasnoyarsk, whence I took the first good train to Verchni Udinsk—a regular frontierstown—then another long trip on the Selenga River to Khiakhta, and from there a wonderful trip to Mongolia.

(To be continued)

STREAMLINING THE SOVIET WATERWAYS

By Dr. W. O. BLANCHARD

PROFESSOR OF GEOGRAPHY, UNIVERSITY OF ILLINOIS

FOR a country so vast, so compact and so lacking in open ports, Russia has been dependent to an extraordinary degree upon *inland* transport. Yet, until a decade ago, the ordinary facilities for such haulage—the roads, the railways and the waterways—were notoriously poor. As a consequence long distance movement of either goods or peoples was negligible and local communities had to be self-sufficing to an extraordinary degree. Not until the First Five Year Plan was inaugurated in 1928–29 was the nation's transportation system scheduled for a thorough overhauling—a job long overdue!

Highways Few and Poor. Of all the country's commercial facilities, the highways have been found most wanting. The United States had, in proportion to area, about twenty times the mileage of Russia. Actually the disparity was even greater than this ratio suggests, for many of the Soviet rural "roads" were mere trails across the country, unimproved in any fashion, unfenced, not even graded! They were distinguished only as parallel wheel tracks in the dirt. Naturally they were passable only during extended fair weather. It was not unusual for villages to be cut off from the outside world for from two to six months at a time when prolonged rains or spring thaws made travel impossible.

Inadequate Railroads. Although they had long been the main dependence of the country's transportation system, the railway facilities had also lagged far behind the needs of the nation. They were lacking in mileage, in equipment and in efficient operation. Here again the United States, in proportion to the area, has about twenty times as much main trackage. Much of the Soviet mileage was originally laid without careful planning, while many lines were built with an eye chiefly to their strategic importance. Equipment was mostly purchased in western Europe, where short hauls were the rule. Small cars, hand-operated brakes, light rails and engines, poor bridges and inadequate ballast—all in a bad state of repair—this was the sorry picture of the Soviet railways in 1928.

Waterways Poorly Developed. The inadequacy of roads and railroads had for long served to emphasize the importance of water carriage. Yet, on the whole, that service was about as backward as the others. Little effort had been made to dredge the streams, equip fleets or build terminals to handle the traffic. Even the most elementary port equipment was lacking. In the half century ending in 1910 expenditures for railways were seventy-five times as much as for river and canal improvements. Steamers were used on only one fourth of the navigable streams, and canals or canalized rivers made up less than 1 per cent. of the total mileage of rivers suitable for navigation or timber floating. The traffic was not only small, but in recent years it was declining rapidly. Thus, from 1913 to 1936 it decreased by two thirds! Under the Czars the tonnage moved on all the rivers combined was very little more than that carried by the Rhine River alone.

Natural Handicaps to Water Transportation. Superficially, Soviet rivers would seem to be well suited for navigation. Actually, in their natural state, they leave much to be desired, and their modernization has been anything but

easy. While they have ranked *second* to the railways in traffic the waterways have certainly ranked *first* as a headache for the commisar in charge of communications.

The fact that the country is a vast plain is, of course, advantageous in rendering streams navigable. However, the *extreme* flatness of the terrain leads to poor drainage—to vast areas of marsh, ponds and shallow lakes as well as to a dearth of stone for construction works.

The climate offers still more serious handicaps both as regards temperature and precipitation. In the extreme north the rivers are frozen for about six months; in the south, for at least two months. Likewise the highly seasonal

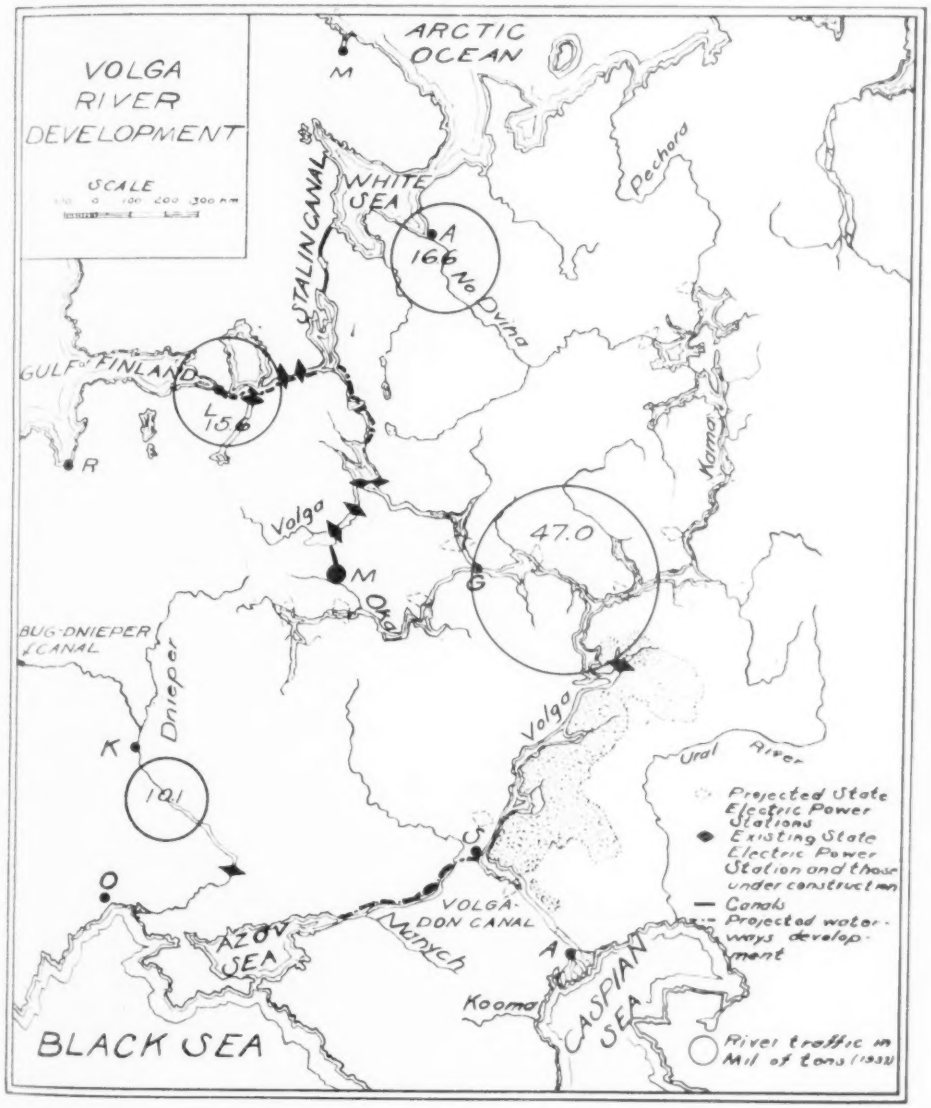


FIG. 1. INTERIOR WATERWAY SYSTEMS

character of the precipitation and thawing results in alternate periods of flood and low water.

Finally, the limited commercial importance of the coastal waters restricts the usefulness of their tributary rivers as links in the foreign trade routes. Practically all the coasts are ice-bound at least part of the year. In addition the Baltic and Black Seas can be and, at times, have been, easily blocked by foreign powers, while the Caspian is, of course, an *inland* sea.

It should be noted, however, that waterways transportation is favored by the bulky nature of the freight to be moved. Timber, oil and grain are of this type, the first mentioned accounting for over one half of the total water-borne tonnage.

General Character of the Volga. The Volga is Europe's longest river, and with its tributaries it offers a navigable length of some 7,000 miles. The entire drainage basin of about half a million square miles is the home of 50 million people. Including water extensions, completed or in the course of building, it reaches from the Baltic-White to the Caspian-Aral-Black Seas, from the land of furs to the land of cotton.

The Volga in many respects resembles our own Mississippi. The two are practically the same length. Both rise in marshy areas at comparatively low elevations. Both wind leisurely across vast interior plains without notable interruptions by falls or rapids—in fact, their average gradients are almost identical, about three inches to the mile. Both discharge through vast deltas. Both suffer greatly from the scourge common to most rivers—a widely fluctuating volume, with the usual accompaniment of migrating sandbars, snags and shifting channels. Mark Twain, as a Mississippi River pilot would have been quite at home on the Volga!

In a number of respects, however, the Russian river appears at a decided disadvantage. Its watershed is about half as large and the total volume of precipitation is only one fourth as great as the Mississippi, so that part of its basin is practically desert. While both suffer from ice, the Soviet river is affected throughout its entire course. Still more serious, however, is the fact that the Russian waterway empties into an inland sea—not into the open ocean.

The Volga system plays the dominant role in Russia's interior waterway carriage (see Fig. 1), accounting for almost as much tonnage as all the others combined. The enormous extent of its navigable waters assures the existence somewhere in the system of all the major handicaps and the merits of the country's waterways.

The Upper Volga. Of the three major commercial weaknesses of the Upper Volga, low water in summer and ice in winter rank first. Almost as serious is the fact that without artificial connections the headwaters are "blind alleys." Finally, instead of serving the nation's capital city the river curves around it in a great bend, thus minimizing its usefulness to the great Moscow industrial region.

As a remedy for these defects, little could be done about the ice, but dams, completed or under construction, are designed to correct in considerable measure the fluctuations in volume.

The need for joining the headwaters with the northern sea coast was long ago recognized. As early as 1810 the connection was actually made by a series of canals and canalized rivers. Some 43 wooden locks were used and the water journey from Moscow to Leningrad required from one to two months. Present plans call for a complete modernization of this thoroughfare with depths about 2½ times those of the old channel. This waterway joins the Volga at Rybinsk, where a great dam and reservoir have just been completed.

FIG. 2. THE STALIN CANAL WHERE IT JOINS THE WHITE SEA

THIS CANAL IS APPROXIMATELY THIRTY-SIX MILES LONG AND TWELVE FEET DEEP. ENERGY IS GENERATED AT FIVE HYDROELECTRIC STATIONS ALONG ITS COURSE.

FIG. 3. THE STALIN CANAL CUTS THROUGH OLD GLACIATED ROCKS

IN NORTH RUSSIA. THE MAXIMUM ELEVATION OF THE CHANNEL IS 325 FEET; BOATS ARE RAISED AND LOWERED BY NINETEEN WOODEN LOCKS.

This link between the Baltic and Volga will also give access to the White Sea and Arctic Ocean by means of the Stalin Canal, recently completed. This latter, between Lake Onega and the White Sea, in some 36 miles long and 12 feet deep (See Fig. 2). It cuts through a low plateau of ancient rocks—the European counterpart of the Laurentian Plateau of North America (see Fig. 3). The channel reaches a maximum elevation of 325 feet, the boats being raised and lowered by 19 wooden locks. Waterpower is generated at 5 hydroelectric stations. The energy will be used for the chemical, metallurgical and lumber industries. The waterway will tap the supplies of granite, timber, fish (from Barents Sea) and coal (from the Pechora Field).

It will be noted on the map, Fig. 1, that the Upper Dnieper has now been joined with the Bug-Vistula, so the Black Sea as well as the Caspian will have direct water connections with the Baltic.

The third objective—bringing the Volga to Moscow—has also been attained. The capital city is located on the Moscow River, a small tributary of the Oka, which in turn is a major branch of the Volga. Commercially the Moscow River was of little value. Fluctuations of depth were extreme. Three fourths of the whole year's discharge has been known to pass in a single month, so that in late summer it was too shallow to use. Railroads handled forty times as much of the Moscow traffic as did the river. Furthermore, Moscow drank over one half of the river's discharge, and at the present rate of growth the city would, about five years hence, consume it all. Under the Czars less than one half of Moscow's buildings had water connections and only one fourth were provided with sewer connections.

By constructing a dam across the Upper Volga north of Moscow, the impounded water has been diverted south

FIG. 4. A SCENE ALONG THE MOSCOW–VOLGA CANAL SYSTEM

SINCE THIS PROJECT WAS COMPLETED THREE YEARS AGO, RIVER FREIGHT HAS AMOUNTED TO ALMOST FOUR MILLION TONS AND MOSCOW IS FURNISHED WITH AN ADEQUATE WATER SUPPLY.

into the Moscow River channel, thence into the Oka and finally back into the middle Volga at Gorki. Five huge hydroelectric stations raise the water over the intervening divide. In the three years since the completion of this project the river freight has amounted to three and three-fourth million tons, and the city has at last been able to enjoy an adequate water supply (see Fig. 4).

The Lower Volga. Like the Upper Volga, the lower section also suffers from three major handicaps to transportation. They are (1) insufficient water, (2) a vast delta and (3) lack of access to the open sea.

Scant precipitation and excessive evaporation, combined with a lack of tributaries, work a hardship upon navigation on the lower Volga. Likewise, much of this drainage basin is steppe or desert —agriculturally, marginal land, except where irrigated. The remedy being applied is the construction of dams for better control of the waters. Incidentally, the hydroelectric power will be used largely for irrigation pumps. As shown on the map, Fig. 1, the right bank of the lower Volga is bordered by bluffs; the left bank is a low, broad flood plain inviting irrigation.

The delta offers a major problem. One of the distributaries had been canalized by dredging, but even so it has been too shallow for Caspian steamers. The level of the sea has been falling in recent years, greatly aggravating the difficulty. Caspian steamers, according to reports in 1940, were not able to get nearer than thirty-five miles of the delta canal.

The methods of shipping petroleum illustrate these inadequate facilities. Caspian tankers from Baku, some as large as 9,000 tons, go as close to the delta canal as possible and there unload into barges which are towed by tugs to

FIG. 5. CASPIAN STEPPE REGION SCENE BEFORE IRRIGATION
EXCEPT WHERE IRRIGATED, MUCH OF THIS DRAINAGE BASIN IS AGRICULTURALLY MARGINAL LAND DUE TO LACK OF PRECIPITATION AND EXCESSIVE EVAPORATION.

FIG. 6. BAKU PETROLEUM WILL SOON BE ABLE TO REACH TIDEWATER
VIA THE VOLGA-DON CANAL. NEAR THE DELTA CANAL CASPIAN TANKERS FROM BAKU HAVE TO UNLOAD THEIR PETROLEUM INTO BARGES WHICH ARE TOWED TO ASTRAKHAN.

FIG. 7. FROM STURGEON COMES CAVIAR—FAMOUS FOOD OF THE VOLGA
THE BEST CAVIAR, WHICH CAN ONLY BE MADE IN WINTER AND IS DIFFICULT TO PRESERVE, IS THE LOOSELY GRANULATED KIND KNOWN IN RUSSIA AS *ikra*.

Astrakhan. There another transfer is made to river barges, which carry it upstream.

The land-locked Caspian is a blind alley and possesses but a poor hinterland. The solution proposed and now being carried out is the Volga-Don canal. At one place the Volga comes within 50 miles of the Don, and the proximity of the two streams has long suggested their union here. For navigation this will require 6 locks on the Don and the dredging of that river to its mouth. Three hydroelectric stations are involved. In addition to power and navigation the project is intended to help stabilize the Caspian level by directing part of the upper Don into it. Additional water for the shrinking Caspian will be obtained by damming the headwaters of several Arctic rivers, *e.g.*, the Pechora and North Dvina and directing the waters via the Kama-Volga to the Caspian (see Fig. 1).

Middle Volga Improvements. The rectification of the Middle Volga consists chiefly in building a number of dams making reservoirs arranged in a steplike series. These will regulate the volume and provide electric power and irrigation water. The extremely gentle gradient—2.0 to 2.5 inches per mile—the lack of solid rock foundations for the great dams and the densely populated farm lands to be flooded are some of the major engineering problems involved.

Of the 15 dams proposed for the whole Volga the one at the great Samara Bend will create a lake of 2,900 square miles. The two hydroelectric stations here will have a capacity eight times the total electric power generated in all Russia in 1913 and it will have almost twice the capacity of the Grand Coulee—now the world's largest! Some 10,000,000 acres of desert and steppe north of the Caspian will be irrigated, the flow of the river will be regulated and 100 miles of river navigation eliminated (see Fig. 5).

At present Volga steamers must draw less than six and one-half feet, and at certain seasons they may go up stream as far as Tver. From that point to the mouth is 1,650 miles via water—a journey of months—but less than 900 miles in a straight line. At the end of the Third Five Year Plan a depth of 9 feet is promised from Moscow to Astrakhan, the same depth now provided from Chicago to the Gulf of Mexico.

FORESTS AND PEOPLE

By R. F. HAMMATT

ASSISTANT TO THE CHIEF, U. S. FOREST SERVICE

THE evidence of Eocene flora, made up of once-living trees, strongly refutes the hypothesis of continental drift since that geologic time.[1] There is, however, ample evidence that forests influence the drift of mankind and the welfare of nations, and that forests have been and are influenced by people.

This latter evidence goes back at least to the time when Uni—whose name appears on a historical text discovered by Mariette in the necropolis of Abydos—was "Inspector of the Woods of the Royal Domain of the Pharaoh Teti." A later inscription records Rameses III, of the Twentieth Dynasty, as having "planted trees and shrubs to the end that the people should sit under their shade."

The Old Testament refers to extensive forests that helped establish the maritime supremacy of an ancient Mediterranean civilization, but recent aerial views reveal a tragedy of land use near the Lebanon mountains. In "The Earth as Modified by Man," George P. Marsh tells of forests that have disappeared, of vegetable earth and mold that have washed away and of rivers famous in history and song "that have shrunk to humble brooklets" in what was once the powerful and prosperous ancient Roman Empire.

The high forests of Corsica and Sardinia were bases for the sea power of the republics of Pisa and Genoa, just as the forested slopes confronting the eastern shores of the Adriatic Sea were for that of Venice. But in all three cases reckless forest exploitation was responsible in no small part for the present economic poverty of the areas concerned.

As author of "Forests and Sea Power," R. G. Albion makes the statement that influences of the shortage of timber in England when Cromwell ruled extended to many diverse fields. It was felt, he says, "not only in the Navy itself, but in international law, in naval architecture, and in England's foreign, colonial, commercial, and forest policies as well." Illustrating man's influence on the forest, Pack and Gill in "Forests and Mankind" recall that once the sun never set on that magnificent tree we variously call tulip tree, tulip poplar, yellow poplar and white wood. It once grew, they say, in all parts of the globe, but "now there are only 2 species left, one in America and the other in far off China. From the rest of the world the tulip tree has vanished utterly."

According to Raphael Zon[2] there are three broad but major stages in the relations of man to forests, and of forests to man. The first stage, he says, is the one in which the forests dominate civilizations; in the second, civilizations are overcoming the forest; while civilizations dominate the forest in the third stage.

Forests dominated, Dr. Zon points out, when they acted as barriers to the spread of the Hamites from north Africa southward. When they kept the Bahima from the Congo, and limited the eastward expansion of the Inca empire from the high plateaus of Peru and Bolivia. When, largely because of difficulties they imposed on travel, they served as political boundaries in the old world and the new.

[1] "Bearing of Forests on the Theory of Continental Drift," by Dr. Ralph W. Chaney, in SCIENTIFIC MONTHLY for December, 1940.

[2] "Forests and Human Progress," published in *The Geographical Review* for September, 1920.

FOREST EXPLOITATION OF LONGLEAF PINE LAND IN MISSISSIPPI

WHICH WAS CLEAR-CUT ABOUT FIFTEEN YEARS AGO. THE POLICY OF EXPLOITATION IS STILL PRACTICED BY MOST PRIVATE OWNERS OF FOREST LAND.

AN EXAMPLE OF GOOD FOREST MANAGEMENT BY A PRIVATE OWNER

IN MISSISSIPPI WHO CUT FIFTY-EIGHT TREES PER ACRE BUT LEFT ON EACH ACRE THIRTY-FIVE TREES THAT WERE FIFTEEN INCHES AND OVER IN DIAMETER. (COMPARE WITH PHOTOGRAPH ABOVE.)

WATERWAYS HELPED MAN TO OVERCOME THE FORESTS

THE ANDROSCOGGIN RIVER FULL OF SPRUCE PULPWOOD LOGS FROM NEAR THE WHITE MOUNTAIN NATIONAL FOREST, NEW HAMPSHIRE.

Although dominating civilizations in the first period, forests provided deer and other wild game, and helped shelter and defend mankind. Robin Hood in Sherwood Forest offers an illustration in point. Caesar's Commentaries have many references to the part forests played in the resistance of the Gauls to the Roman legions. Before the age of iron and steel British ships of the line had great masts that were cut in Maine, topmasts that had grown in the Ukraine, smaller spars from Norwegian mountainsides, planking that had floated down the Vistula, with curved frame timbers from Sussex oaks. And—although here we jump to Zon's second and third stages in the relations between men and forests—pioneers in our own naval stores industry drifted southward and westward as local timber was exhausted, then followed the longleaf pine all the way to the open plains of the Brazos. After which "the sons and the sons' sons of the original tar heels of the piney woods hitched up their mules . . . and returned to the Carolinas to start over again on the second growth forests . . . that a kindly creator had grown for them in their absence."[3]

Dr. Zon says that man was essentially a hunter when forests dominated; that European man began to dominate the forests when he started clearing them to make room for new plants that yielded more food; and that it was in this second stage that extensive clearings showed up in German forests.

It was not until Negroes had arrived along Central America's shores that forests were affected by the food motive there. Clearing of forests in southwestern France was begun by the Vandals some 1,500 years ago. With "not enough open space to establish a 40-acre farm" in what Ernest Bruncken[4] calls "the great Atlantic subdivision of North American forests," clearing there became a necessity soon after the first colonists arrived. And as their grim struggle continued, there developed a resourceful and dynamic backwoods type that, with roots sunk deep in familiar forests, charted the course of a new nation through the days of its youth.

Waterways and axes and fires helped man to overcome the forest. The Rhine offered a route along which extensive openings could be made in German forests. Without the Androscoggin, the Penobscot and other rivers, many a New England forest clearing would have been postponed. Without axes and fire, many American pioneers would have found it almost impossible to fell and then get rid of all the trees from clearings made for corn, and for a space to se the Indians before they could get close to the settlers' cabins.

Most early clearings in America were made to conquer and subdue the forest as a matter of necessity, but exploitation began as an eager, land-hungry people moved northwest and southwest, then west and ever west. This exploitation, and forest fires, spread and grew as railroads and falling saws supplemented rivers and axes; as steam instead of rivers made larger and faster sawmills possible; as ox teams gave way to donkey engines; and as gasoline—and then diesel—tractors and "cats" roamed the woods.

In outline, this was how our forests were overcome.

We have carved an empire out of a wilderness while dominating forests, and history is studded with references to the resourcefulness and ingenuity with which this has been done. But in the process the forests on privately owned

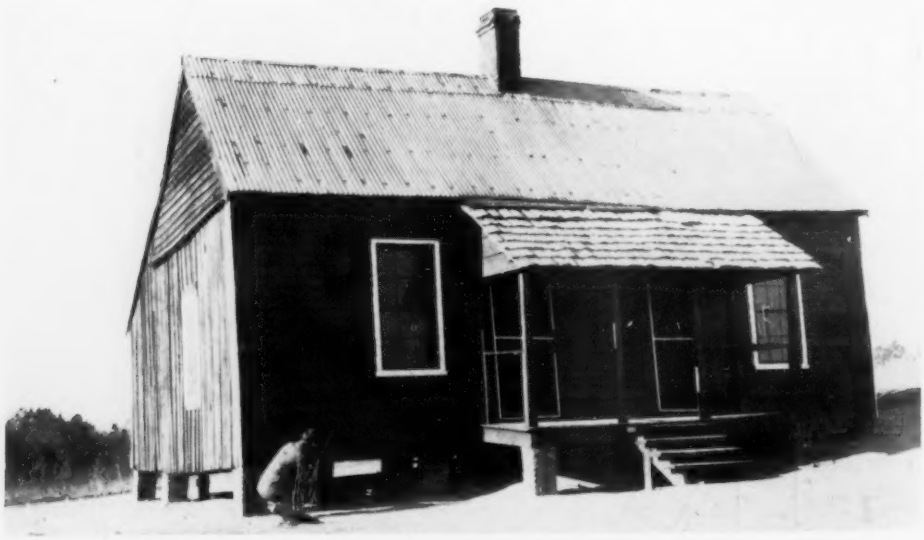
[3] "Tar Heels of the Piney Woods," by I. F. Eldredge, published in *American Forests* for February, 1937.

[4] "North American Forests and Forestry," published by the Knickerbocker Press, 1908.

WATERWAYS HELPED MAN TO OVERCOME THE FORESTS
THE ANDROSCOGGIN RIVER FULL OF SPRUCE PULPWOOD LOGS FROM NEAR THE WHITE MOUNTAIN NATIONAL FOREST, NEW HAMPSHIRE.

A HOUSE TYPICAL OF THE RURAL SLUMS

THIS DWELLING WAS INCLUDED IN THE FOREST SERVICE STUDY IN THE SUMTER NATIONAL FOREST IN SOUTH CAROLINA. FOREST EXPLOITATION IS LARGELY RESPONSIBLE FOR RURAL SLUMS.



REHABILITATION HELPS SOLVE SOCIAL PROBLEMS IN MANY RURAL SLUMS

THE PICTURE SHOWS SIMPLE BUT EFFECTIVE IMPROVEMENTS TO FOUNDATION, FRONT STEPS, WINDOWS, CHIMNEY AND PAINT, AS COMPARED TO THE CONTRASTING PHOTOGRAPH.

land—which makes up the best and the most accessible three fourths of all our commercially productive forest land and furnishes about 95 per cent. of the timber we use—have been cut so destructively for so many years that the forest resource as a whole has become widely and seriously crippled.

In the Northeast, including New England, for example, more than 2½ billion feet of lumber now has to come in yearly on ships and freight cars which might otherwise be used to transport food and guns and munitions. Our greatest reserve of virgin forests is in the Pacific Northwest. Yet in eastern Oregon and Washington the privately owned pine timber large enough to harvest will probably be exhausted in two decades or less at pre-war rates of cutting; in the Douglas fir region of western Washington there are only about 20 privately owned saw-timber holdings with enough big timber to last 10 years at 1940 cutting rates; some of western Oregon's counties have already been practically stripped of merchantable Douglas fir.

Drains in the South have been heavy and long continued. Three fourths of the forests there are now second growth, more than two thirds of all the merchantable pine is in trees less than 17 inches in diameter, and most forest land is growing only one third to one half the crop of wood it should grow. There were once vast virgin forests in the Lake States. The remaining privately owned spruce there is now being clear-cut or high-graded, only about 1.9 million acres of the privately owned hemlock and hardwood saw-timber forests remain uncut, and most of the Lake States land that originally bore big pines is covered with grass, bracken, aspen and scrub oak and pine.

Exploited and depleted forests are serious enough, but rural slum conditions—which destructive cutting on private land, and other things, have helped in varying degrees to create—are more so. For until recently these slum conditions affected the lives and the outlook on life of 8 millions of farm people who for decades had been living under conditions involving shelter and diets so inadequate that poor health was general. This meant wide-spread inability to do a good day's work even if work were available. It meant high relief loads. And it meant young folk too many of whom were physically and temperamentally and educationally poorly equipped to function as future citizens of this or any other democracy.

Most of the worst of our rural slums occur within areas where the forest resource has been crippled but still offers what appears to be a major opportunity for sound social and economic rehabilitation. In itself this is a striking illustration of the need to keep all forest land continuously producing all the usable products and services it can produce.

Wood is one of these products. It is one of the world's most useful and valuable raw materials. It can be grown with less cultural effort than any other land crop. No other living product of the land can approach its flexibility as to time of harvest, or its capacity to accumulate stores of widely used basic raw materials like cellulose. Forage and water are other forest-land products. Grazed by domestic livestock, forage contributes to the meat, wool and leather that are needed in war and in peace, while water from forested slopes irrigates cultivated crops on millions of fertile acres.

One service of forests is the wages they make possible; wages that in the past have supported close to 13 million people yearly. Another service is recreational use. It is now big business. Well-managed forests help prevent erosion and conserve the soil on which all life de-

FOREST LANDS PROVIDE RECREATION IN A LAND OF MARVELOUS BEAUTY
AN ISLAND CAMP SITE ON LAKE INSULA, IN THE SUPERIOR NATIONAL FOREST, MINNESOTA

pends. They also help minimize the height and frequency of floods, maintain the navigability of streams and harbors, and regulate water used for domestic purposes, for irrigation and for generating hydro-electric power.

Services like these rival timber growing in importance. They indicate what in "Farmers in a Changing World" Gove Hambridge calls "the increased awaredness of the human aspects" of certain basic problems. They also clothe forest land with a public interest that, in the world of today, must of necessity take precedence over the interests of individuals or groups.

Private forest land—which is the best and most accessible three fourths of all our forest land—has always been dominated by destructive cutting, but the evidence is clear that in recent years an increasing number of forward-looking industrial and other leaders, no longer content with fire protection, have also put worth-while cutting practices into effect on forest land they own.

This represents real progress. With certain developments on publicly owned and managed forest land, it affords added proof that destructive exploitation and deterioration of the forest are unnecessary even to help win the war. However, there is also evidence that progress still falls way short of maintaining that forest resource on which agriculture and labor as well as industry and commerce must depend to help cushion many critical post-war readjustments and win the peace.

According to recent annual and other reports of Dr. Earle H. Clapp, who has emphasized that all forest-land resources

CROP GROWING IN THE LEE OF A SHELTERBELT

THAT IS PART OF THE 11,000 MILES OF LIVING WINDBREAKS PLANTED DURING THE LAST FIVE YEARS BY THE FOREST SERVICE THROUGH ITS PRAIRIE STATE FORESTRY PROJECT.

FOREST LANDS PROVIDE RECREATION IN A LAND OF MARVELOUS BEAUTY
AN ISLAND CAMP SITE ON LAKE ISABELLA, IN THE SUPERIOR NATIONAL FOREST, MINNESOTA.

and services must of course be made available in such amounts and at such times as may be necessary to win the war, this evidence reveals in part:

> That as late as 1940 there were more than 149 million acres of privately owned forest land that needed but did not get organized fire protection, and forest management of any kind was still lacking on close to 70 and 85 per cent. of the commercial forest land in farm and industrial ownership, respectively.
>
> That even in 1936, a depression year in which production levels were low, all forest drain in both saw timber and cordwood stands was at a rate which, in relation to all usable forest growth, represented a net annual deficit of some 4 billion cubic feet of wood.
>
> That in this, our first war year, destructive practices are still the rule when most privately owned forests are cut. *And*
>
> That in this first year of war the combined cut of saw timber and cordwood bids fair to increase to a point where drain is 50 per cent. greater than all effective forest growth.

Dr. Clapp, who is acting chief of the Forest Service, has pointed out that it seems unfair to try to put all the responsibility for these conditions on forest industries; that in his opinion the public is also responsible because of its indifference, and the Federal and State governments because they have allowed such conditions to continue. He has contended that the scope, character and diversity of the problems affecting most private owners of forest land, and the vital public interests inherent in this land and the services it and its resources perform, warrant and make essential the extension of public cooperation and aid to private owners by State and Federal Governments.

But the acting chief of the Forest Service has also pointed out that the time for temporizing—for depending entirely or even largely on public cooperation or on the initiative of private owners—has passed; that although we need both of them, the time has come for such other

SPECIAL PERMITS FOR FAMILY OCCUPANCY OF BUILDINGS LIKE THIS ONE IN A NATIONAL FOREST IN KENTUCKY ARE ISSUED BY THE FOREST SERVICE, AS THERE ARE MEANS TO REHABILITATE ONLY A SMALL FRACTION OF THE PLACES THAT NEED IT.

HUMAN REHABILITATION AND FOREST REHABILITATION GO HAND IN HAND
ONE OF SIXTY-FOUR FARMSTEAD HOMES IN THE EXPERIMENTAL SUBLIMITY, KENTUCKY, FOREST COMMUNITY BUILT BY THE FOREST SERVICE NEAR THE CUMBERLAND NATIONAL FOREST.

measures as will assure the stopping of destructive cutting on private forest lands and the keeping of those lands at least reasonably productive. And positive assurance, he has said, lies in two measures and apparently only two: Nation-wide public regulation of cutting and other forest practices on private forest land, and public ownership and management of much more forest land.

Both these measures are included in a comprehensive forest program. This program, endorsed by the Department of Agriculture, has for its long range objective the establishing and maintaining of a nation-wide forest economy that will help solve problems of rural poverty and unemployment and create security and stability for families, industries, communities and regions that depend upon the forest resource.

In addition to public regulation the first part of this program—which is a 3-part one—includes public cooperation with and aid to private owners of forest land in such things as: Protecting their lands against fire, insects and diseases; retaining existing markets and uses for forest products, and finding new uses and new markets; helping forest owners to solve their problems; making public credits available to owners who are willing to give their forest holdings good management but who need credits to do it; and removing inequalities with respect to State and local property taxes on forest land.

The public ownership measure is in the second part of the program. It calls for extension of community, State and Federal ownership and management of forest land that is submarginal for productive use under private ownership, and forest land on which private owners can not or will not protect vital public interests. This measure contemplates the public

NATIONAL FOREST PONDEROSA PINE LANDS UNDER MANAGEMENT

NEAR SENECA IN EASTERN OREGON. NOTE THE HEALTHY RESERVE STAND, WHICH WILL RESEED THE AREA, AND THE ABSENCE OF WIND THROW AND DEBRIS.

CLEAR CUTTING OF PRIVATELY OWNED PONDEROSA PINE LAND

NEAR SENECA IN EASTERN OREGON. NOTE THE SPARSE RESERVE STAND, THE WIND THROW, DEBRIS AND THE ABSENCE OF REPRODUCTION. (COMPARE WITH PHOTOGRAPH ABOVE.)

acquisition of some 140 million to 150 million acres, with communities and States going as far as they will, but the leaving of more than one half of all commercially valuable forest land in private ownership.

This second part also recommends additional facilities for protecting, developing and using the existing national forests and their resources, plus such lands and resources as may be added to them, and for making the national forests still more outstanding demonstrations of public ownership, public administration and public service.

The third part of this 3-part nation-wide action program has to do with more adequate provision for research for both private and public forest lands, their resources, the services—such as watershed protection, outdoor recreation and wildlife conservation—that forests render, and the social and economic problems involved.

A MEXICAN RETURNING HOME WITH FIREWOOD
GATHERED IN THE GILA, NEW MEXICO, NATIONAL FOREST.

Most industrial and other private owners of forest land enthusiastically endorse the public aid and public research parts of what is known as the Forest Service program. But many of these owners strongly oppose the public regulation part. They claim that it, and especially Federal leadership in it—is new and revolutionary. They assert that it disregards the Bill of Rights. They characterize it as bureaucracy run wild. Let's forget it, they urge, and concentrate on winning the war.

Many people doubt the new and revolutionary part of this view-point. Professor P. L. Buttrick may be one of them, for in his "Backgrounds, Methods, and Problems of Public Regulation of Private Forests"[5] he holds that "the very nature of forests is such that public interest in them . . . has existed from time immemorial, and their control has long been a governmental function." Also that the system of forest rights established in Medieval times "recognized [the forest] as a public utility . . . laid the basis for existence of public forests, and later led to the development of modern methods of public management regulation designed to keep all forests productive."

There seems to be doubt, too, if nation-wide public regulation of private forest land, with Federal participation in it, would disregard the Bill of Rights. For the fifth amendment to the Constitution provides, in part, that "no person shall

[5] *Journal of Forestry* for March, 1941.

be . . . deprived of life, liberty, or property without due process of law," and under the public regulation as proposed all aggrieved forest owners are assured of having controversial matters decided by that due process of law if recourse to the courts becomes necessary. Moreover, the power to regulate interstate and foreign commerce, *including navigation which is often seriously impaired through erosion and siltation induced by forest devastation*, is delegated to the Congress by Section 8, Article 1, of the Constitution.

There is always danger that bureaucracy may run wild, and we must always guard against this danger. It is therefore fortunate that, in theory at least, most of us are "agin" control of what we think of as the rights of the individual and property rights. But since most of us are also practical, we demand regulation when safety to children as they cross automobile-crowded streets on their way to and from school is at stake; when our families need protection against communicable diseases; when we invoke city or rural zoning or land-use ordinances or State hunting or fishing laws; and when, as a nation, we are threatened by economic or military aggression, or both. For we realize that we as individuals can not do these jobs; that public regulation in many fields is essential to the broad public welfare and fits into the now-accepted framework of the American way of life.

Long before what happened at Pearl Harbor on December 7, last, hundreds of millions of feet of lumber were going into prosaic war-time needs like cantonments, defense housing, factories, ships and docks, while increasing quantities of wood or pulpwood or constituents of wood were being used in the making of more warlike-sounding products such as

NEGRO WORKERS OF THE PINEY WOODS

HARVESTING FOR TURPENTINE AND ROSIN ON THE OSCEOLA NATIONAL FOREST IN FLORIDA.

ONCE A VIRGIN STAND OF TIMBER GREW ON THIS OREGON LAND
THAT IS NOW A "DOUGLAS FIR DESERT" AS A RESULT OF CLEAR CUTTING IN 1924, WHICH WAS FOLLOWED BY FIRES IN 1925, 1929 AND 1933.

nitroglycerin and gas masks and dynamite and flame-throwers.

The production of lumber and pulpwood that will be needed during our first war year bids fair to exceed 1936–40 five-year production averages by close to 35 and 70 per cent., respectively. These 1942 levels represent perhaps a greater impact on forest lands than the impact of agricultural goals on farm lands. Under cutting and other woods practices that are still wide-spread on privately owned forest land, they represent destructive exploitation that has been accelerated by the war but is not necessary to help win it. And these practices are still further depleting and crippling a resource the products and services of which are vital to the everyday lives of a people at peace.

Perhaps this explains, in part at least, why the Secretary of Agriculture has said[6] that we need "and we need now" some form of adequate public regulation of forest practices; why he has expressed the conviction that failure to protect and rehabilitate our forests "would be comparable to tearing down our defense factories, girder by girder, to get steel for munitions"; and why in his message of January 7, 1942, the President reminded Congress that "It is a part of our war effort . . . to conserve our natural resources and keep in repair our national plant."

Perhaps all this illustrates as well as explains, in part at least, the attitude now gaining headway with respect to forests and people; the attitude characterized by a "lest we forget" motif rather than by the "let's forget" one previously mentioned.

[6] "Forests and Defense," released for publication by the Department of Agriculture.

THE NATURE OF WAR AND THE MYTH OF NATURE

By Dr. M. F. ASHLEY MONTAGU

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It is now seventy years since that fatal morning when a dust-laden young Prussian officer galloped into Paris at the head of a small advance party of Uhlans, thus signalizing the capitulation of the French and the unequivocal victory of the Prussians. Forty years later this self-same Prussian officer, now a general, careered into Europe with a book which at once attained a universal notoriety. That book was entitled "Germany and the Next War." It is hardly an exaggeration to say that no book of a similar nature had before, nor has any book since, been so fervidly and widely discussed. In England, at any rate, the book passed through more than a score of impressions in as many weeks. As a child, then living in London, I well remember the sensation it caused, and how often I saw it in the most unexpected places. Since those days I have learned that the volume used to be kept on tap in the precincts of those lesser parliaments, the pubs, where those who "talked politics" could freely consult it over a tumbler of beer or a pipe. In this book the author, General von Bernhardi, boldly threw down the gauntlet to the world, and virtually with sabre in hand called upon the German people to protest against "the aspirations for peace which seem to dominate our age and threaten to poison the soul of the German people." It is understandably rather hard for an iron-headed soldier, after some forty years of comparative inactivity, to recall an event so stirring as the entry at the head of a victorious army into a defeated enemy's capital, without feeling that if things were not actually going to the dogs it was, at least, high time that something were done to prevent the possibility. And so in order to convince the German people of the "unnaturalness" of that "inactivity which saps the blood from a nation's sinews," von Bernhardi did something that he had never done before; he wrote and published a book, making the pen, as it were temporarily, do service for the sword, and ink for blood. "War," declared von Bernhardi, "is a biological necessity"; it "is as necessary as the struggle of the elements in Nature"; it "gives a biologically just decision, since its decisions rest on the very nature of things." "The whole idea of arbitration represents a presumptuous encroachment on the natural laws of development," for "what is right is decided by the arbitrament of war." In proof whereof such notions of Darwin's as "The struggle for existence," "natural selection" and "survival of the fittest" are invoked with a sententiousness inversely proportional to its sense. According to von Bernhardi, it is plainly evident to any one who makes a study of plant and animal life that "war is a universal law of Nature."[1]

This declaration and fortification of Germany's will-to-war—for it had the highest official sanction and approval—was published in 1911. Three years later the greatest holocaust the world has ever known was launched upon its ghastly way by those

[1] "Germany and the Next War," Popular Edition, 16th Impression, pp. 14, 18, 20, 23-24, 30, 34.

vultures sick for battle
Those bloodless wolves whose dry throats rattle,
Those crows perched on the murrained cattle,
Those vipers tangled into one,

the inhuman, militaristic Bernhardis, the legislators of a victimized Europe.

The Great War came to an end twenty-two years ago, having cost the lives of thirteen million men, eight million of whom were slaughtered upon the field of battle, and ten million civilians, who died either directly or indirectly as a result of the war. As for the maimed and wounded combatants, these amounted to a mere twenty million. The cost of running this fracas amounted to $125,000,000 a day during the first three years, and $224,000,000 during 1918, the total cost of the killing amounting to some four hundred billion dollars.

This year considerably more than the total income of the governments of the world will be spent on armaments. The war that has for the last ten years appeared inevitable has already been with us for two years, and although there is hardly a human being now living, with the exception of the militarists, who can see either sense, good or anything but misery in war, my revered friend and teacher, Sir Arthur Keith, continues to aver in several recent articles[2] that war has its biological justification. Sir Arthur Keith maintains that the impulses which lead men to aggressive and defensive wars are "Nature's mechanisms for preserving the individual and the tribe or nation," and "which make individuals and nations willing to risk life itself to further the means and opportunities of life."

Sir Arthur Keith's opinions upon this subject first came into prominence with the publication of his Rectorial Address to the students of Aberdeen University in 1931, published in the same year under the title "The Place of Prejudice in Modern Civilization." These opinions he has recently reaffirmed. In the present article I propose to take Sir Arthur Keith's views on the nature of war and, treating them as representative of the views of the biological-nature-of-war school, subject them to a brief critical examination.

Keith begins by declaring his firm conviction that "prejudices are inborn; are part of the birthright of every child." These prejudices "have been grafted in our natures for a special purpose—an evolutionary purpose." "They are essential parts of the evolutionary machinery which Nature employed throughout eons of time to secure the separation of man into permanent groups and thus to attain production of new and improved races of Mankind." "Nature endowed her tribal teams with this spirit of antagonism for her own purposes. It has come down to us and creeps out from our modern life in many shapes, as national rivalries and jealousies and as racial hatreds. The modern name for this spirit of antagonism is race-prejudice." "Race prejudice, I believe," continues Keith, "works for the ultimate good of Mankind and must be given a recognised place in all our efforts to obtain natural justice for the world." And now for the passage which has gained such wide-spread notoriety:

> Without competition Mankind can never progress; the price of progress is competition. Nay, race-prejudice and, what is the same thing, national antagonism, have to be purchased, not with gold, but with life. Nature throughout the past has demanded that a people who seeks independence as well as peace can obtain these privileges only in one way—by being prepared to sacrifice their blood to secure them. Nature keeps her orchard healthy by pruning; war is her pruning-hook. We can not dispense with her services. This harsh and repugnant forecast of man's future is wrung from me. The future of my dreams is a warless world.[3]

Essentially similar views were ex-

[2] *The Truth Seeker*, N. Y., March, 1939; *Sunday Express*, London, 27 August, 1939; and *Man*, London, April, 1940, pp. 61–62.

[3] "The Place of Prejudice in Modern Civilization," New York, 1931.

pressed by Sir Arthur Keith in his Robert Boyle Lecture, "Nationality and Race" (1919). Now, unlike von Bernhardi, Sir Arthur Keith is a physical anthropologist of the first rank, and, as I well know, a man of the noblest and most generous nature; nevertheless, in his treatment of the subject of prejudice and war the fact is unfortunately betrayed that he has overstepped the frontiers of his own particular field,—to which he has made such lasting and classical contributions,—with results, to say the least, that are not altogether happy. Charles Singer has well said that "Even professional men of science, when they pass beyond the frontiers of their own special studies, usually exhibit no more balanced judgment or unprejudiced outlook than do non-scientific men of comparable social and educational standing." Sir Arthur Keith's Rectorial Address may be taken as a case in point.

What, we may ask to begin with, is this *Nature*, always, it is to be observed, spelled with a capital *N*? Keith's Nature is apparently a very intelligent affair, working things out purposefully and with much premeditated thought. I use the term *intelligent* here in a general sense to cover the operations of what is conventionally known as the *intellect*. It would seem, however, that an intellect which can conceive of no better device to improve its breed than by warfare must be a very poor intellect indeed. For surely the biological vitality of a species can be preserved and improved by a large variety of immeasurably more effective means than this; means which do not necessitate or require the annihilation of a single individual. But what, indeed, *is* this Nature of von Bernhardi and Keith which, according to them, makes war a biological necessity? Apparently it is anthropomorphism akin to the elan-vital of Bergson or the life-force of Shaw. In other words, it is God with the capital *G* in very much the old form, divested here and there of a few sacraments, and perfectly clean-shaven, but otherwise much the same. Voltaire's jibe that if God had made men after his own image they had returned the compliment, is as appropriate a truth to-day as it ever was. Nature or God to-day is an anthropologist as well as a mathematical-physicist, sometimes an entelechist, and often enough merely a set of differential equations, unlimitedly limited and with an infinite number of functions at one and the same time, but if the truth were really known, merely a set of conditioned reflexes! In fact Nature may mean anything according to the whim of the user. Nature, says Aristotle, makes some men slaves and others free; by Nature, retorts Cicero, all men are free. In Nature, says Hobbes, "the life of man is solitary, poor, nasty, brutish, and short"; it is a condition of "war of every man against every man," in which "the notions of right and wrong, justice and injustice have no place," and "force and fraud are the two cardinal virtues." "The state all men are naturally in," replies Locke, is "a state of perfect freedom to order their actions . . . as they think fit, within the bounds of the law of nature. . . . a state of equality." "Nature," writes Wordsworth, "to me was all in all, she never did betray the heart that loved her." "Nature," rejoins Tennyson, "red in tooth and claw, shrieks against the creed of man." And as Professor Pollard has remarked of these antinomies, "Some see red, others see God, it all depends upon the kingdom that is within them." In effect, Nature is the name we give to the projection of the totality of our ignorance concerning the forces which are conceived to be responsible for the generation of life and its maintenance. Nature is not a "thing-in-itself" which operates upon other things; the term denotes rather, if it denotes anything at all, an artificial con-

struct, the purpose of which is to serve as a general stereotype for our ignorance, in addition to serving as a *deus ex machina* to which, in a quandary, we may appeal in order to be comfortably relieved of our perplexities. For most people to say that a thing is Natural explains it. But does it? What do we mean by Natural? Prejudices are natural according to Keith and others, poetry according to M. Jourdain, warfare according to von Bernhardi, and the golden lie according to Plato and some of his modern successors. Nature, it is said, is the universe of things as made or produced. Nature, it is added further, operates according to definite laws. All, in fact, is determined by law. The movements of the planets are determined by laws as immutable as those which determine the behavior of a dog or a man.

But all this is mythical.

The universe, as far as we know, is composed of a system of ever-changing *relations,* in the form, for example, of gases, stresses, forces, strains, velocities, dimensions, substances, and so on, truly *ad infinitum.* Nothing in it is fixed, all is flux. Between certain limits of infinity, that is, in a given space-time continuum, the relations of certain planetary velocities, for example, may remain (relatively) constant; the recurring averages in which these relations manifest themselves may be calculated to a high degree of probability, and when so calculated may be stated as laws. These laws are always probability laws and are valid only as long as the relations of the planetary velocities, as well as numerous other factors, remain (relatively) constant; should, however, any of these relations change, the old law will have to undergo modification, or an entirely new one will have to be elaborated.

With this in mind we may proceed further. A unicellular organism living at the bottom of a stagnant pool and environed by a stable universe of stimuli will tend to undergo little change as long as the constancy of those stimuli persist, but modify its relations, the form and nature of the stimuli acting upon it, alter its environment, and if you go on long enough, say for a few thousand million years, sufficiently and adequately varying the nature of the environmental stimuli, not to mention the inherent tendency of the organism to vary, you will, let us suppose, produce a man. And your man, as an organism, will obviously represent the sum of the effects of the responses to the environment organically made by his ancestors. Organically your man will be the product of an innumerable variety of conditions—the changing relations collectively termed *heredity* and *environment.* So will, and so indeed is, any plant or any other form of animal life. Thus, all plant and animal life is not *produced* according to definite laws but in response to a series of arbitrary or *chance* alterations in the relations of the factors affecting it. Nature is thus not an intelligent teleologically directed process which acts according to predetermined law, but is a composite of chance relations which may be arbitrarily observed as unit-groups of recurring averages of relations, the behavior of the independent variables, or the quanta, of which being both indeterminable and unpredictable, whence the *principle of indeterminacy.* Man, indeed, owes his present supremacy to just such a series of indetermined chance relations, which may more briefly be described as an accident of accidents, the accident referred to having been initiated in the early Miocene epoch approximately some fifty million years ago, when owing, most probably, to the denudation of the forests due to causes which at present remain speculative, a number of chimpanzee-gorilla like creatures, resembling the extinct ape known to paleontologists as *Sivapithecus sivalensis,* were forced down from the trees

and were constrained to assume a life upon the ground, this revolutionary change in their immediate environment leading ultimately to the development of all those physical characteristics which we have learned to recognize as distinctive of man. Those apes who lived in the unaffected regions stayed up in the trees and therefore still remain apes. Was there any directive, telic, intelligent natural force at work here? Not at all. A devastating series of environmental changes accidentally precipitated may have been responsible for the descent from the trees. The colossal number of varied forms of life, extinct and living, that are to be found upon this earth to-day have arisen owing to very similar causes. Every form of life with which we are acquainted is due, or rather, owes its peculiar form, to the infinite number of changes that have been and are in progress of taking place in the environment peculiar to each—the internal as well as the external environment—these changes are not regulated by law but by chance. The processes of the universe of life are discontinuous and infinitely variable. The universe consists of an infinitely changing series of relations. Action and reaction, stimulus and response, take place always *relatively,* never *absolutely.* Nature, in short, in the determined immutable sense of the traditionalists does not exist, save as a procrustean fiction.

The law and order that man sees in Nature he introduces there, a fact of which he seems to have grown quite unconscious. Natural systems of classification work so well, that, following an unconscious pragmatic principle they are assumed to be true, or at least, representative of the truth, the latter being conventionally defined as correspondence with the reality of whatsoever it may be; in this way the tacit assumption is made that one has but to seek and one will find the law and order that is undoubtedly there in Nature. This process is termed *discovery.*

Now, while systems of classification are of incalculable value in aiding the processes of understanding and discovery, such systems are none the less quite artificial and do not in any way reflect a law and order which characterizes the operations of the processes we commonly ascribe to Nature itself. Nature is a fiction which uses neither measuring-rod nor time-table. It is man alone who uses such instruments in order that he may the more fittingly orient himself in relation to this self-created fiction. The classificatory systems of man are *fictional devices,* and represent merely the attempt—and it is a grand attempt—to unravel the tangled skein of some of the relations of the various forms of life and substance to one another, but no more. But of this man loses sight, and confuses himself with the belief that the law and order which he has worked out into an arbitrary scheme is that law and order according to which Nature works. *Homo additus Naturae,* remarked Bacon long ago. Nature, if it consists of anything represents a series of discontinuous processes, a complex of entangled gossamer strands, which man attempts to gather together and spin into a web which he naïvely imagines is the *real thing,* the real thing being merely as he sees it, and he sees it in an infinite number of ways, according to the kingdom that is within him. Nature comes in this way to mean anything; and what may mean anything, in fact means nothing. Nature is a term without definite meaning. Logically the conception of it is without the slightest value; psychologically perhaps, the term may not be without some significance in the sense of Nietzsche's words in "The Joyful Wisdom": "Laws and laws of nature are the remains of mythological dreaming."

With respect to the "war of Nature"

which is alleged to be a "universal law of Nature," that, it must be said, is pure fancy. We are told that even trees and flowers "fight." Do they? There is not the slightest evidence that they do. And if they do, what connection has this "fighting" with the warfare practised by men? Some flowers digest insects; some plants "strangle" others. Does this constitute war between the flowers and the insects concerned? Do the plants that strangle others have to plead guilty to murder? Are these "warlike" actions of plants and flowers advance or rearguard actions? It would be extremely helpful to know whether it is defensive or offensive war that is natural. Sir Arthur Keith believes that both are. The illegitimate use of such terms as *struggle, fighting, force,* and so on, when applied to plant and animal life, and the deliberate confusion of these terms with *war,* is too often made and far too often allowed to pass unchallenged. I cannot resist quoting Professor Pollard in this connection, who entertainingly remarks of this confusion:

> The sun and the moon, we suppose, declare war with great regularity because they get into opposition every month. Parties in the House of Commons are perpetually at war because they are opposed. The police wage war because they are a force; for *naturally* if we use force against a criminal, we must needs make war upon other communities. War, indeed, will last for ever, because men will never "cease to struggle." So the League of Nations has obviously failed whenever a stern parent is caught chastising a peccant child; and "fighting" will go on without end because drowning men will fight for life, doctors will fight disease, and women will fight for places at drapery sales. And this is war![4]

The case could not be put more neatly. Man, like other creatures, kills a large number of animals for food and various other uses. Does the process of killing and consuming these animals constitute war? In any case, is the killing of those animals either necessary or *Natural*? It is neither innate in the psychophysical structure of man, nor necessary in order that he may live, to kill any animal whatsoever, or plant, for the matter of that; at least not for men living in the highly civilized centers of the Western World. Man's taste in food is culturally determined, like his taste in cigarettes or alcohol. In primitive conditions of life he is forced to kill animals for food and apparel, just as it was *natural* a short time ago to kill prisoners of war in order that the food supply might not unnecessarily be depleted. Animals in the wild state kill large numbers and varieties of other animals, where they are available, for the satisfaction of their hunger, for the very good reason that they have no other means of remaining alive—but *man* has. Man has improved upon the wild ways of life of the beasts of the jungle, and there is not the slightest reason why he should revert to them. In medieval England it was considered natural and perfectly legal for all claims to real property to be settled and tried by battle; since then man has developed more peaceful means of settling such claims, not by blood but by reason, by virtue of an understanding made possible by a more enlightened form of culture. For culture, if it means anything, represents the fact of man's ability to elaborate and improve upon the normal processes of the Universe, commonly called Nature; in a very real sense to elaborate and improve upon his original endowment; and indeed to-day through means purely cultural man is in a position to control and regulate, in every possible respect, his own future evolution. He holds the power within himself of total self-extermination or more complete development, and it is by the weakness or strength of his intellect alone that either the one or the other effect will eventually be brought about. Fundamentally, man is quite an intelligent animal, but he is a victim, alas, of the two-handed engine of his culture which distorts his mind and renders

[4] Vincula, London, 1925.

him unintelligent. Outworn traditional teachings have made of Western man a shockingly unintelligent creature who lives under the continuous and unrelieved domination of a chaos of ideas more degrading, more stupid, more idiotic and more saddening than it may ever be possible to describe. This confused morality has, without question, been substantially responsible for his present deplorable state, for the reflexes and patterns of thought of every child born into the Western World to-day have been conditioned according to the prescriptions of these teachings, so that culturally Western man has come to be a function almost entirely of the reigning spirit of confusion and prejudice. And since in his conduct he functions without effort as a victim of confusion and prejudice, he arrives at the belief that it is thus *natural* to act and to think. In this way is produced the mentally and spiritually bludgeoned individual who gropes his way confusedly through life—and whose number is legion. It is in his world alone that to-day war still remains a legitimate and defensible means of settling a dispute or forcing an issue.

With respect to Keith's "race-prejudice" that, of course, is a purely acquired sentiment, a constellation of socially manufactured emotions, as he would undoubtedly have known had he made as deep a study of cultural as he has of physical anthropology. Nature according to him secures the separation of man into permanent groups by means of the operation of race prejudices, which express themselves as natural rivalries and jealousies, in order to produce "new and improved races of mankind." This, we suppose, is a form of natural selection operating upon psychological bases, a form of selection peculiar to man alone, for no other animal, as far as we know, exhibits the slightest symptom of anything akin to what Sir Arthur Keith calls "race prejudice." So-called race prejudice among lower animals, like their so-called natural fears and terrors, are *acquired* not inborn. Experiments on young animals first carried out by Benjamin Kidd many years ago, and by numerous investigators since, conclusively prove that the "instinctive" fear and terror of their allegedly natural enemies exhibited by the adult members of the species, are emotions which are generally completely absent in the young, and that they are acquired only by *learning* from other members of the species, or by individual experience. A lamb or any other animal, for example, which has had no long association with members of its own species from whom it could have acquired the fear—or past experience with lions, will exhibit not the slightest fear of a lion when confronted with one.

No animal or human is born with any fear or prejudice whatsoever, either of snakes, mice or the dark, to cite but a few of the most familiar common fears usually considered as of "instinctive" origin. All such fears or prejudices are *acquired* by learning, and may, and usually do, act as conditioned reflexes, simulating physical reflexes which are innate, but which in the former cases are conditioned to react culturally—not biologically or instinctively.

Upon the innate prejudice theory how are we to account for the well-authenticated fact, familiar to most people of experience, that children of one nation brought up in the milieu of a "foreign" nation feel no prejudices whatsoever, in wartime or out of it, against the nation of their adoption, but on the other hand are generally to be found in the ranks of their adopted land fighting against the motherland of their ancestors, whether it be in ideas or in powder? The most notorious example of this is the case of Houston Stewart Chamberlain, the egregious author of that stupendous miracle of nonsense, "The Foundations of the Nineteenth Century," in which the spec-

tacle is witnessed of an apostate Englishman glorifying the Teutonic spirit, and the German brand of it in particular, at the expense, among others, of his ancestral land and heritage. One may well wonder what happened to the "birthright" of prejudice of Chamberlain when, as an adult, he became a champion of German prejudices? Possibly William James's law of transitoriness of instinct may be invoked here! And what shall we say of the author of the "Religio Medici" who wrote, "I am of a constitution so general, that it consorts and sympathiseth with all things; I have no antipathy, or rather idiosyncrasy, in anything. Those national repugnances do not touch me, nor do I behold with prejudice the French, Italian, Spaniard, or Dutch"? As a matter of fact, there is every reason to believe that race sentiment and antipathies are comparatively recent developments in the societies of Western man. Lord Bryce in his Creighton Lecture, "Race Sentiment as a Factor in History" (1915), after surveying conditions in the ancient world, in the Middle Ages, and in modern times up to the French Revolution, arrives at the following conclusions which he regards as broadly true. The survey of the facts, he says,

> has shown us that down till the days of the French Revolution there had been very little in any country, or at any time, of self-conscious race feeling. . . . However much men of different races may have striven with one another, it was seldom any sense of racial opposition that caused their strife. They fought for land. They plundered one another. They sought glory by conquest. They tried to force their religion on one another. . . . But strong as patriotism and national feeling might be, they did not think of themselves in terms of ethnology, and in making war for every other sort of reason never made it for the sake of imposing their own type of civilization. . . . In none of such cases did the thought of racial distinctions come to the front.

In America, where white and black populations frequently live side by side, it is an indisputable fact that White children do not learn to consider themselves superior to Negro children until they are told that they are so, a fact which is beautifully illustrated by the words of a white American farmer from down South, who, in answer to the query as to what he thought of the Negro, replied, "I ain't got anything against niggers; I was fourteen years old before I know'd I was better than a nigger." Numerous other examples could be cited of the cultural acquisition of prejudices, but to enter into a fully satisfactory discussion of the mechanism of race prejudice here would be quite impossible; it need only be said in this place that it has been abundantly proven that race prejudices, or ideas of any kind, are inherited in just the same way as our clothes are, not innately but culturally. The statement so often made that "war is a universal and everlasting law of Nature" is at best a shallow judgment, for it seems never to occur to those who make it that the "conflicts" which they are pleased to term "war" and which are alleged to take place between animals in the wild state are pertinent only when they refer to the conflicts between animals of widely separated species, orders and, almost universally, classes. Thus, mammals prey upon reptiles, reptiles upon birds, and birds upon insects. Lions will attack almost anything that moves, so will, to a lesser extent, wolves and hyenas; domestic cats will kill small rodents and birds; monkeys will kill and eat birds and insects, but in all these examples chosen at random not a single animal will "fight" with a member of its *own* species in the sense that it will fight with members of other species, orders or classes of animals. In the wild state it is not the practice of animals to prey upon or fight with each other, but rather with animals of widely separated species. When they do fight with each other the results are rarely fatal and approximate

more often than not to play. Of course, very hungry animals will devour, upon occasion, members of their own species, but this is a form of conduct which is normally resorted to only of extreme necessity. In serious conflicts between wild or domesticated animals of the same species the fight is invariably between rarely more than two individuals, and the fight is usually provoked by the same causes and is fought from motives similar to those which cause men to fight with one another, namely, the possession of a sexually desirable mate, or an object of physical value such as food. But this sort of fighting is a very different thing from the fighting which we know as "war." War is an organized attack of one community upon another community, and as such is never fought by animals other than those of the "human" variety. It is impossible to produce a single instance from the animal kingdom, outside of man, in which it is shown that within a definite species a form of behavior resembling warfare is waged by one group of its members upon another, or for the matter of that upon any other order or class of animals—as a means of improving the species or what not. If one thing is certain it is that it is *not* natural for either members of the same species or of any other to wage "war" upon one another. War, let it be said at once, is the most unnatural, the most artificial, of all animal activities, for it originates in artificial causes, is waged by highly artificial entities called states, is fought from artificial motives, with artificial weapons, for artificial ends. Like our civilization war is an artificial product of that civilization itself, the civilization that has been achieved by the repeal and the repudiation of those very processes of so-called Nature which our von Bernhardis are pleased to regard as an everlasting universal law.

We have already seen that there is good reason to believe that aggressive race sentiment and prejudice is a comparatively recent acquisition of man. So too, there is very good reason to believe that warfare is but a recent development resulting from the artificial and perverted activities of men living in highly civilized groups. Amongst the extinct races of men of whom we have any knowledge no evidence of anything remotely resembling warfare has ever been found. Plenty of weapons of a rather simple nature have been discovered in association with the remains of ancient man but these were clearly for use against animals, and not against himself. Adam Smith long ago pointed out that a hunting population is always thinly spread over a large area and possesses but little accumulated property. Primitive man was, and in many cases still is, a hunter, and no doubt, as is the case amongst most existing primitive peoples, his hunting grounds were marked off by definite boundaries, boundaries separating different communities, "but these boundaries were sacred, and as no one would think of violating them they could not form a cause of war." Wars for conquest among primitive peoples are completely unknown.

"Savages," writes Ellis, "are on the whole not warlike, although they often try to make out that they are terribly bloodthirsty fellows; it is only with difficulty that they work themselves up to fighting pitch and even then all sorts of religious beliefs and magical practices restrain warfare and limit its effects. Even among the fiercest peoples of East Africa the bloodshed is usually small. Speke mentions a war that lasted three years; the total losses were three men on each side. In all parts of the world there are people who rarely or never fight; and if the old notion that primitive people are in chronic warfare of the most ferocious character were really correct, humanity could not have survived. Primitive man had far more for-

midable enemies than his own to fight against, and it was in protection against these, and not against his fellows, that the beginnings of cooperation and the foundations of the State were laid."

War came into being only after men had taken to the cultivation of the land upon which it was necessary for them to settle permanently. Such an agricultural stage of development we know first to have appeared among men not more than twenty thousand years ago in the Magdalenian Age. The agricultural life results in the accumulation of property, the accumulation of property results in more or less organized industry, industry in wealth, wealth in power, power in expansive ambitions and the desire to acquire additional property—the source of additional power—necessary to gratify those ambitions, and thus by no very complicated process—in war. Such conditions as are peculiar to the industrial civilizations of to-day are, of course, highly artificial, as are the prejudices and race sentiment which they serve to generate.

In the modern world undoubtedly the most potent cause of war is economic rivalry—a purely cultural phenomenon having no biological basis whatsoever. The desire for foreign concessions, and foreign markets, the increase in population, "lebensraum," such things will upon little provocation set nations in opposition and at each other's throats. It is from such economic causes that patriotism, chauvinism and the widespread fear of aggression, which more than anything else serves to consolidate the group and is responsible for the generation of race sentiment and prejudice, is born.

If all this is true, then it is apparent that war arises not as the result of natural or biological conditions but from purely artificial social conditions created by highly "civilized" modes of living.

There remains to be examined the statement given expression by Sir Arthur Keith, and implied in the writings of many before him, that war is Nature's "pruning hook," Nature's method of keeping her orchard healthy. This, of course, means that war acts as a process of natural selection—an idea which on the face of it is preposterously absurd, for, as everyone knows, the manner in which modern war acts is to kill off the very best members of the race whilst jealously preserving the worst, such as the mentally and bodily diseased and the generally unfit. And in any case, as the last war fully proved, the nation superior to all others in the processes of waging war, the most ingenious and fertile in the invention and use of the instruments of destruction, may in spite of this lose the war by the selectively irrelevant fact of being overwhelmingly outnumbered. In writing of the late war Professor Pollard has in this connection aptly remarked that "if the result had depended on scientific invention the Germans would have won. As it was, they neutralized enormous odds in numbers to such an extent that for four years the principal front hardly shifted on an average more than half a dozen miles in either direction. The Allied victory was due not to scientific superiority but to the economic exhaustion of the foe, and to the fact that in Foch's decisive campaign America was pouring more fresh troops into the line of battle in a month than the Germans could raise in a year." From the standpoint of natural selection it is apparent to all those who lived through it that the Germans, who proved themselves the most intelligent and certainly not the least valorous of all the combatants, should have won the last war. Instead, they lost it. Something, clearly, has gone wrong with natural selection, or rather with war as an agency of it. As a matter of fact the whole concept of war as an agency of natural selection in the case of man completely breaks down

when we consider that throughout the historic period there were numerous instances of victories in war gained by nations who were culturally far inferior to the peoples whom they conquered. It must, however, be freely acknowledged that on the whole up to the modern era the nations victorious in war were generally superior to the people whom they conquered—superior in the strict sense of the *military* superiority of the combatant *individuals*. In former wars men actually fought with one another, the superior warrior generally killing the inferior in hand-to-hand combat. But in modern warfare the combatants scarcely ever see each other, and when they do it is not military skill or native superiority which decides who shall die, but a shell fired from a battery some five to ten miles away, or a machine gun hundreds of yards distant, or a bomb dropped from an aeroplane a mile or more up. In actual battle the superior men are the first to go over the top, in dangerous and generally useless raids they are the first to be chosen—and killed. Where in all this slaughter is there to be detected any symptom of natural selection? Selection, certainly, in that the superior are selected for death and the inferior are protected against it—in this way does modern warfare act as an agency of natural selection—for the worst.

Man has reached his present supremacy of reason through the inhibitive and integrative powers of his mind, the ability to reject and suppress what he considers to be undesirable, the ability to *control*. Human society depends upon the maintenance of that ability of the mind to control, not so much the brute in man—for there is really little that is brutal in him that is not forced upon him—but those elements which under miseducation are capable of making a brute of him. All that is fine, noble, beautiful and desirable in our civilization has been achieved by the supercession of mind over Nature, and much of this has been achieved through the resolute determination of individual minds not so much to conquer and to vanquish what is customarily called "Nature" red in tooth and claw, but to enlist the aid of "Nature" in the service of man, and to control it effectively. All that is so ugly and inhuman and so destructive in our civilization is due to the activities of those who are anxious to exploit their fellow men to their own advantage and who use measures of control only towards this end. To them war is a profitable activity, for it increases their fortunes and thus their power. It is individuals of this order, in all countries, and from the earliest historical times, who make wars, not Nature: "the fault, dear Brutus, lies not in our stars, but in ourselves."

Let those who are wise enough awaken to the fact that too long have they been deceived by a chaos of ideas for which there is not the slightest basis in fact, but which represent, as Spinoza said, the errors of the ages grown hoary with the centuries. Let men realize that such flowers as bloom in the verbal spring of such thinkers as von Bernhardi and Sir Arthur Keith have nothing whatsoever to do either with the logical case or the factual reality. Nay, in spite of Kant *et al.*, there is no instinct towards peace in man just as there is none towards war. The early Egyptians, the Cretans, and the people of Mohenjodaro in India, did not wage war because it was totally unnecessary for them to do so; socially and economically they were entirely sufficient unto themselves. Aboriginal Australians, however, have fought with one another, because for economic reasons—such as a dog or a wife—it was necessary for them to do so. Men, it seems, only fight when and if they want to; there is nothing within their native

structure, no *primum mobile*, no innate prejudice, save for such prejudices as have been cultivated in them by education, that originally forces them to fight.

The tradition of thought which renders possible such glib talk of war and its supposed natural causes as I have here surveyed, represents the bequest to us from the remote past of obsolete modes of thought which are conspicuous for their profound irrationality. So powerful is this traditional detritus that it has not failed to influence many of the most respected minds of our day, to the extent of making mathe-magicians of our mathematicians, casuists of our philosophers, and an apologist for war of the gentlest and among the wisest of our anthropologists. This tradition constitutes a Gordian knot that is so tied that to escape its bondage one must sever the knot completely—since it resists being untied. At present this tradition of thought constitutes the sole constrictive force operating upon the mind of man as well as the main impediment in the way of its rational functioning, coercing the good in him towards evil and, in short, representing a tyranny of the strongest and subtlest power. If man is to be saved from himself before it is too late this tyranny must be broken, and this can only be achieved by the unequivocal action that must follow upon the reasoned dissolution of such errors of belief and thought as form so great a part of our traditional social heritage to-day.

POPULATION TRENDS IN THE UNITED STATES

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THE United States Censuses of 1930 and 1940, together with the vital statistics of the last few years, make it clear that the population of this country is undergoing important changes. At least four major trends seem to be well established: the population is increasing at a steadily lower rate and is fast moving toward stationariness; the growth of the city is slowing down and some cities are losing population; the poorer classes are continuing to multiply at a greater rate than the rest of the people; and the old age segment of the population is greatly increasing. Stated thus simply, there would seem to be nothing of extraordinary importance in these trends. When analyzed, however, it becomes clear how they ramify and reach into almost every aspect of personal, social and national life.

I

The first bold fact which recent data bring out is that the growth of the United States is slowing down and slowing down rapidly. This phenomenon, though general nearly throughout the Western world, is more impressive in the United States because of the rapidity with which its population grew up to a few decades ago and because of the sharpness with which that growth is declining. The inhabitants of this country increased thirty-three times in a century and a half: from less than 4 millions at the time of the first census in 1790, to 23 millions in 1850, to nearly 76 millions in 1900 and to nearly 132 millions in 1940. But the rate of growth has dropped rapidly, almost precipitously, especially recently. The birth rate decreased from an average of 42 per thousand in the 40's and 50's, to 37 in the 60's and 70's, to 30 in 1900, to 26 in 1910–1919, to 20 in 1928 and to 17 in 1938. The rate of total increase (natural increase plus immigration) dropped from about 36 per cent. per decade until 1860, to 21 per

cent. from 1890 to 1910, to 15 per cent. from 1910 to 1920, to 16 per cent. from 1920 to 1930 and to about 7.2 per cent. during the 1930–1940 decade. This last rate is less than one half the rate for any decade since 1790. In absolute numbers, the increase was a little over 10 millions in 1880–1890, nearly 13 in 1890–1900, nearly 16 in 1900–1910, nearly 14 in 1919–1920, 17 in 1920–1930 and in 1930–1940 about 9 millions. The decline in rate of growth is so marked that the population of the country will stop increasing and become more or less stationary within the next few decades.

The basic reasons for this decline are somewhat obscure. The reduction of immigration, sometimes believed to be the cause, can not be held responsible because the decline was already well established when immigration was in full flow. Some attribute it to the great depression, but the decline began long, long before the autumn of 1929, and the period that has followed. Others find the source in birth control, but the slowing down of population growth is general and not confined to those segments of the population which practice birth control; furthermore, birth control is but a symptom, or a means, not itself the basic cause. Still others attribute the decline to the stress of city life, to a desire on the part of large numbers of people to follow personal ambition and to spend their energies and money in other ways than having children, to the growing insecurity of our era. All these and other factors have probably had an influence in bringing about the decline, but they themselves are rooted in deeper causes which remain more or less unexplained.

This trend would seem to be in the order of a natural phenomenon. The population of this country increased at such a rapid rate in the eighteenth and first part of the nineteenth centuries that it could not possibly have continued to increase at the same rate indefinitely. So long as population was small it could double itself in twenty-five years or so without producing extraordinary pressure on resources; but when it reached a hundred millions or more, it could not possibly go on multiplying at the same rate. Although the figure is not strictly applicable, it would be like expecting a balloon which in the early stages of inflation had expanded at a high rate to continue to expand at the same rate when it was almost fully inflated. In other words, the present reduction in the rate of increase is in the very nature of things; and students of population foresaw it half a century ago and have been able to measure and even predict it with increasing accuracy.

There is no reason for alarm, however, in this slowing down of population growth. The slowing down will be gradual. Were the population suddenly to stop growing, that would be a serious matter, since it would produce a considerable disturbance in the economic system and other aspects of our society. In fact, the population of this country will continue to grow for several decades to come: it will increase to about 141 millions in 1950, 150 in 1960, 155 or 160 in 1970. It will probably become stationary, at perhaps 175 or so millions, in the latter part of the present century; but the societal structure will gradually adjust itself, and the changes *per se* need not and probably will not cause any major disturbance.

The slowing down of growth and even a stationary population may, in fact, be advantageous. This country now enjoys a marked advantage in the matter of resources. With a crude density of about 41 per square mile at present and a crude density of 47 per square mile when it does reach a maximum population of 175 millions, this country has and will continue to have an enormous advantage over other nations. What this

means can scarcely be realized. France, for example, has a density of 198 per square mile, Germany 372, Italy 360, Japan 492, England and Wales 703. Crude density is not, of course, the truest of measures, as only the relation between population and resources, especially land, can give the true position of a country. Yet even the ratio between population and usable land alone gives and will continue to give the United States a marked advantage; for, while most countries are already using nearly all their usable land, in the United States it is estimated that 322 million acres more can be added to the 478 million acres now in improved farming.

A slower growth or a stationary population, therefore, is not something to be feared; it will call for adjustments, as we shall see below; but in its totality it is to be desired; it will make it possible for the people of the United States to continue to enjoy an abundance of resources and a relative good standard of living; and it will give them opportunity to stabilize, if they will it, their economic life, and even to eliminate some of the economic maladjustments which now prevail.

II

The second striking fact which recent Census data bring out is the slowing down in the rate of city growth. In this respect, also, a marked change has occurred. The urban population in the United States increased more or less steadily from the founding of the nation to the recent past: from 6 per cent. of the total population in 1800 to a little over 15 per cent. in 1850, to nearly 40 per cent. in 1900, to 56.2 per cent. in 1930, to 56.5 per cent. in 1940. In addition, the number of large cities also increased: from 6 cities of 100,000 or over in 1860, to 19 in 1880, to 34 in 1900, while in 1930 there were 93 cities with 100,000 or more population, and five cities with one million or more inhabitants.

This expansion of urban population, however, began to slow down after 1900; during the 1920–1930 decade the decline became marked, spreading to practically all sections of the country, while 532 cities actually lost population; and by the 1930–1940 decade the decline in city growth became very pronounced.

The reports of the 1940 Census make this clear. During the 1920–1930 decade, the cities grew 25.5 per cent., while the country as a whole increased 16.1 per cent.; in 1930–1940, the cities grew 5.0 per cent., the country 7.2 per cent. Again, whereas only 23 cities of 25,000 and over declined in population in 1920–1930, 108 or nearly five times such cities experienced a decline during the 1930–1940 decade. In 1940 there was one less city with 100,000 population than in 1930. Moreover, while the 25 largest cities experienced a marked growth during the previous decade, they either lost population during the last ten years or increased very little: seven increased but slightly; nine lost population (Jersey City losing enough to be displaced from the list of the 25 largest cities); five, namely, Boston, Cleveland, Philadelphia, Pittsburgh and St. Louis, lost all the way from 0.7 to 2.4 per cent. of their population; Chicago barely escaped a loss by having a gain of one fifth of 1 per cent.; while New York had an increase of only 6.5 per cent. Los Angeles and Miami were the only two which increased appreciably in 1930–1940: Los Angeles 21 and Miami 34 per cent.

The reasons for the retardation of city growth are clear. First, there are limits to sanitation, communication, transportation, housing, etc., and when a city reaches considerable size, its rate of growth naturally decreases. Second, the city is not growing so rapidly as in the past because non-urban population growth has slowed down. Since the city depends on rural population for its replacement and since the increase of rural

population has itself been slowing down, the city can no longer draw from the rural areas to the same degree as in the past; the net migration from farms to the cities was approximately 6 millions in 1920–1930, while it was only 2,179,000 in 1930–1940. Third, the city was the destination of nearly 90 per cent. of the foreigners who entered the country, but since immigration has virtually stopped —in fact, 30,000 more persons left than entered this country during the last decade—the city has lost this source of growth also. Fourth, there has been some decentralization of industry and a considerable removal of residence out of the metropolitan centers. And finally, the depression has made life in the larger cities less and less secure and life in the country relatively more secure. A factor which may accelerate this trend in the coming decade consists of the vulnerability of the great city to aerial attacks. It is possible that some of the war industries—no small proportion of total industrial enterprise—will be located at points away from the large cities, where land is cheap enough to make possible a subterranean development of these.

Whatever the forces at work, the slowing of city growth need not be regarded with apprehension. As the preliminary Census figures were being published during the summer of 1940, one could almost hear the people of Philadelphia, Boston and New York groan over the fact that their city had not increased so fast between 1930 and 1940 as in the previous decade. They seemed to be humiliated, as if a misfortune had overtaken them.

The slower growth of the city is certainly not a misfortune and may prove to be a definite advantage. Objective students of society have known for some time that rural life is more favorable to marriage and to a sane married and family life; that rural people live longer (if that is an advantage in these times); that the death rate is lower in rural areas, despite notoriously inadequate medical services; that the rates of divorce, dependence and other maladjustments are lower in the country districts; that life is simpler, more socially direct, less sophisticated, less infected with organizations or stifled by "total" materialism. The rural community is not, to be sure, a paradise, for it contains as bad festers as the city; still all in all it affords an opportunity for as high if not a higher standard of life than the larger city for the masses who live there.

A retardation of increase of urban population may also contribute to the stabilizing of city life itself. Some of the worst evils of city life, such as slums, high rents, sweat shops and political corruption, have been concomitants of rapid city growth and need not necessarily be permanent features of city life itself.

The slowing down of city growth, advantageous or disadvantageous though it may be, will, however, have important results. It will probably produce an excess of agricultural population, an overpopulation in the denuded areas, and a further lowering of a standard of living which is already shockingly low in some agricultural areas; it will accelerate migration of laborers and thereby increase such instability of family life as prevails in rural areas; while such cityward movement as will continue will be ever more selective in that it will draw mainly the most capable and fewer of the less capable, thus making the problem of rural leadership more difficult.

These results will call for economic and other readjustments. An agricultural-industrial economy will need to be developed, by the systematic introduction of small industries in the rural areas, providing for duality of occupation and supplementary income for the farm population; capital will need to look increasingly away from the city and more toward the rural areas for the ex-

pansion of both production and business activity; while wage and hour laws will need to be modified to make possible these developments. The educational, public health, recreational and other facilities of the country districts will need to be improved, even beyond the remarkable record already established.

III

The third broad fact recent data—in this case vital statistics—bring out is that the underprivileged, as in the past, are increasing at a greater rate than the privileged. This is not a new fact, but only recently have we had precise data. These data clearly show that for some decades business and professional people have had the lowest rates of increase, the skilled and semiskilled coming next, and the unskilled having the highest rates. The size of the family also has been decreasing rapidly for the "upper classes," moderately for the middle and wage-earning classes, while farmers' families have increased in size, farm-renters 5 per cent. and farm laborers 13, between 1900 and 1930. There are other evidences that point in the same direction. For example, families having an annual income of less than $750 and those on relief are estimated to have contributed one third of the 2,000,000 births which occurred in the United States in prosperity-year 1929; those engaged principally in agriculture contributed 55 per cent. of the natural increase for the entire country in 1930–1935; while the largest proportion of this increase was made by the poorest elements of the farm population. In fact, the poorest farm population had in 1930 an increase of 76 per cent. more than necessary for its own replacement.

This fact, that the poorer elements of the population are contributing more than their proportion to the population is nothing new; "the poor are always with us," and have probably always reproduced themselves at a greater rate than the rest of the people.

What is new is the anxiety which one often hears expressed over the fact. This anxiety, in turn, is based on the notion that the so-called lower classes are generally of low quality. How this idea arose and became rooted in this country, which only yesterday held the "shirt sleeves" philosophy, is in itself an interesting story. It seems to have arisen alongside the birth control movement to be entertained mainly by those who are not reproducing themselves, and to contain elements of sadism. That is, people who have no children and who thereby see their families being extinguished get a sense of compensation for that loss by considering those who do perpetuate themselves as "inferior," to which the "inferior," if articulate, might well reply in the words of Daly's poem:

> My "keeds ees no good breed," you say
> Ah wal, ess mabbe not,
> But day weell be more good som' day
> Dan dose you don'ta got.

In any event, the notion of the inferiority of the underprivileged does not rest on scientific fact. There is no evidence that low income, unskilled occupation, meager or no education, poor habitation or even color, ethic background and nationality have anything to do with biological or other kind of inferiority. Heredity and environment are so inextricably interwoven that no reputable scientist dares claim that one or the other is responsible for poverty, lack of education or what not.

Nor is the idea of the inferiority of the lowly based on historical fact. This country was inhabited from the first and has been brought to its position among the nations of the earth by the "common people"; the "common people," from the days of the Puritans and the Pilgrims to this, have contributed a considerable proportion of the population; they have directly furnished at least

their proportion of the leadership of the country, as any biographical list, such as the "American Biographical Directory" or "Who's Who," will show; and they indirectly contributed to collective leadership by constantly replenishing the city population. Some really monumental leadership has arisen from the lowly; that has been one of the glories of this nation. Now, unless we are willing to claim or to admit that the population of this country is as a whole of an inferior type or that its leadership is poor, we are forced to conclude that we need not be alarmed over the fact that the poorer classes are contributing so much to the population. In fact, since the professional and other "upper classes" do not at any time replace themselves, the "upper classes" would constantly diminish and even disappear in a few generations were it not for the steady rise of leadership out of the masses.

IV

Perhaps the most important aspect of the present population situation in this country consists of the marked change which is taking place in the age composition. In 1870, for example, nearly 50 per cent. of the population of this country was 19 years of age or under, nearly 35 per cent. between 20 and 44 inclusive, and about 16 per cent. were 45 years of age or over; in 1940, on the other hand, 34.5 per cent. were 19 or under, 39 per cent. were 20–44 inclusive, and 26.5 per cent. were 45 years of age and over. Since 1820, the first date for which the age distribution is available for the entire population, the medium age had risen continuously from 16.7 years to 28.9 years in 1940. And more impressive still is the estimate that in the next decade or so this last segment of the population will amount to 30 per cent. of the total.

This "aging" of population has far-reaching significance. First, it proportionately increases the labor forces. During the last decade, persons 20–64 years of age, 60 per cent. of whom are employed or seeking employment, have increased by 7 millions in this country, or from 48 to 55 millions. This increase in the labor force, at a greater rate than the total population, would be an advantage were other conditions favorable. But other conditions are not favorable; they are distinctly unfavorable. Technological improvement has lessened the demand for workers; national income or foreign trade has not sufficiently increased as to take up the surplus; while unemployment has generally increased. Weighing the various factors, it is estimated that 9½ millions potential workers have been added during the last decade, whereas about 3 millions would have been sufficient to supply the needs of the additional population. To absorb this increased labor force, to prevent a permanent dislocation of the market and a decline in the national wealth, calls for a major "operation" in the financial, industrial, business, employment and occupational structure of this country.

Again, the aging of the population is changing consumer habits and therefore will call for modification in production and financial structures. Consumer needs will change; more income will be expended on old-age goods and services, less on children's and young people's. "The market for wheel chairs [may] outsell the market for perambulators . . ."; and there probably will be "less playgrounds and more golf courses . . . less milk and more whiskey." As aged persons are conservative spenders and primarily dependent on savings rather than earnings, capital will flow much more slowly than at present.

Second, as the population ages an increasing number of aged persons will become dependent on the productive workers, particularly in view of the practice, perhaps inevitable, of indus-

trial and business concerns to discard workers of 45 years and over. Part of the burden will be carried by social security and old-age pensions; but much of it will rest on the shoulders of relatives and friends. In the day-by-day weight, these burdens may seem fragmentary and invisible, but in their aggregate they are enormous. In addition, there will be an increase in the burden of taxation. Many more persons will be drawing pensions and drawing them longer, many more will receive care in establishments for the aged and for longer periods; and the state, as well as private philanthropy will be called upon to increase its services to the aged and the solitary.

Third, the aging of population will call for changes in the educational system. There will, of course, be fewer children to educate. There will be relatively fewer children in urban schools: not only their numbers will be proportionately smaller, but if unemployment should continue at the present rate, parents will find it increasingly difficult to maintain their children in school beyond the required minimum. This may be an advantage in the long run, since it will prevent many from going to "college." Reduced numbers will make it possible to eliminate some of the mass-production features of our "higher" education and to approximate a quasi-individual education, provided, of course, staffs are not reduced. The demand for teachers will not continue to expand as it has in recent decades. Urban educational equipment will not need to be enlarged at the rate of recent decades; and administrators may pay more attention to the improvement of personnel. School buildings will be used for longer days and more nearly throughout the year; adult and old-age education will be in greater demand, especially in the cities. On the other hand, the rural educational population will probably be proportionally larger, rural school facilities will need to be expanded considerably; schooling will need to be directed more toward the practical arts and more persons will find their field of activity and happiness as rural teachers and perhaps bring back a part of the rich life-unifying tradition of the "little red school house" which contributed so greatly to the making of early America.

Professional changes will also occur. There will be need for more physicians to deal with old-age diseases and less for those dealing with maternity and child diseases. The movies and vaudeville entertainers will have in part to turn their sex appeal to the retrospective and consolation appeal. And as the aging of population will inevitably increase the death rate, there will be more funeral establishments—politely known as mortuaries—and more mellifluous competitive radio or billboard advertisments setting forth the advantages of being buried in one place as against another.

Again, as women and elderly persons tend to prefer the city, urban centers will come to have a greater proportion of these elements. Embellishing or veneering establishments, so-called beauty parlors, will multiply, and one will see more women sprawling to the view of the passer-by with massive helmets over their heads and latest exotic magazines in their laps; and in the absence of children and grandchildren, more people will rely on the affectional response of dogs, cats, parrots and other animals, and the pet population of every city will greatly increase.

Fourth, the aging of population will probably produce changes in the total outlook of the community. The proportion of youth being small and of the aged larger, some of the "willingness to sacrifice, courage, power of initiative and creative imagination" which characterize youth, will be replaced by "the calm presence of mind, the patient care, and

the greater experience of life," the reflection and retrospection, which characterize the aged. Whether this will necessarily mean a wiser or more efficient living for the community as a whole is a question; perhaps it is doubtful. The tragic events of 1918–1940 make us wonder. The World War reduced the proportion of young people in the great European nations and that may have had much to do with what followed. "It was the young generation, and the best of it, that bled to death on the battle-fields, while remaining to organize peace again were the older generation, the white-feathered stay-at-homes, and a shattered, war-neurasthenic remainder of the youthful generation."[1]

In any event one thing is certain, there will be many conservative persons in the population, older leaders will manage to have longer average tenure and young adults will have relatively fewer opportunities to rise. At the same time, there will be for many of the relatively older persons an increasing amount of leisure and idleness; more time to contemplate the miseries of old-age and dependence; perhaps more discontent and manifestations of discontent; more old women will find self-expression and social contact in political agitation and reform; and there will be more old-age pension activity, more fundamentalist religious sects and more suicides.

Finally, the aging of population means, of course, a proportionate decrease in youthful and young adult elements and this has a definite bearing on the security of the country. France, it will be recalled, worried for decades over the fact that its population was stationary and that of Germany was increasing. The fact that both France and England have a stationary or near-stationary population, while Germany and Italy have higher rates of increase, with the consequent greater proportion of youths and young adults, may have had considerable to do with precipitating what has been termed World War II. In any event, a population that has a higher proportion of young adults has greater plasticity and greater possibilities in the eventuality of war; and this, especially in a time such as the present, is a consideration of no mean importance.

[1] Gunnar Myrdal, "Population" (Cambridge, Massachusetts, 1940) p. 161.

V

The last few sentences may leave the reader with a darksome picture in his mind; and to an extent such a picture is true to fact. He is blind indeed who refuses to see the stark realities of the present-day world. On the other hand, there is a cosmic optimism in the fact that populations have again and again undergone the very changes discussed above and have, somehow, pulled themselves up again, by their bootstraps as it were, at the very moment when they seemed to be sinking into the mire of decadence; and somehow they caught their breath, survived and have started on the path of growth once more; and in the next round of growth they have made some little gain toward the attainment of the good life. So, perhaps, it will ever be till the end of time.

INCUBATION STAGES OF SCIENTIFIC INVESTIGATION

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I

Two preceding articles in this MONTHLY have sketched the development of scientific activity at the northwestern frontier up to 1875 and the contributions made at that time by an earnest group of boys of high-school age as recorded in the minutes of the Young Naturalists' Society. In continuing this narrative we here report additional details of the activity of the society, together with an evaluation of its products. As in previously published excerpts from the minutes, the Reports and other papers are here printed exactly as written by these boys.

The interest attaching to these old papers, it will be recalled, is two-fold—first, as a historical record of the scientific frontier at a critical period, and second, as a human document, revealing germinative stages in the development of eminently successful scientific investigators. A passion for natural science, apparently generated spontaneously, is here projected on the screen in a series of slow-motion pictures caught at the crucial moment when the undifferentiated germ of scientific curiosity is beginning its dramatic career of growth and specialization. Without further introduction, we now resume the survey of these documents.

In secretary Herrick's report at the end of the society's first term (July 2, 1875) he writes:

"We have completed one half year of our existance as a society and it seems propper that we should review the half year's work and see if the result is a good equivalant for the time expended. Among the aims as set forth in the constitution of the Y. N., we find the following.

"1st. 'The promotion of a love of Natural Science.' This I think has been accomplished. . . .

"2d. 'To facilitate the study of the same.' This is perhaps the most important one of all and we think that there has been a good degree of success in this direction. . . . We have indeed lacked the reliable books which we need to aid us on many of these subjects, but have gathered some practical knowledge which can be made available at such times as a book of the right sort comes to hand.

"4th. To give an opportunity for the establishment and preservation of interesting facts or discoveries which may come under the observation of the members. . . .

"5th. 'To provide a correct list of the Fauna & Flora of Minnesota, etc.' This has occupied the larger share of our attention as is right, for it is acknowledged by all that observation comes first and theory afterwards, and we often find societies of young men which devote all of their time to theory and speculation and thus loosing sight of the true means of making theory develop into fact. . . . We think that nothing has been placed in any of the lists aluded to which is not accuratly correct. The following numbers show the practical business of the society for the half year just expired. Specimens collected—

Ornithology,	122
Entomology,	13
Botany,	10

These lists do not include any specimens except those actually taken by the members, otherwise it would assume a more pretentious size, and a large number of specimens in all the branches except Ornithology are now in the possession of members of the society awaiting a chance for identification. . . . Because of the lack of practical information from books we have not made such advancement as might be wished.

"6th. 'To form a collection,' etc. The lack of room has been a drawback to this department and the Museum contains now the following specimens, Birds, 23, mammals 4, minerals 26, and several insects.

"7th. Practical observations, have been

rather a failure but on the whole we have abundant cause for congratulation."

In secretary Lum's report of July 1, 1876, we read,

"The society in the last six months has made but two additions to the list of insects and five to the list of birds, increasing the list of insects to twenty-seven and the list of birds to 174. It is to the Botanical list that the greatest addition has been made. At the beginning of the year there were only ten names on this list while now there are 110."

Secretary Lum reports six months later (Jan. 1, 1877) that the lists of fauna and flora now are as follows: Ornithology, 188; Botany, 131; Paleontology, 32; Zoology, 31. He also lists several accessions to the library. Secretary Roberts' report at the end of the third year (Jan. 14, 1878) was summarized in a preceding article.

The six reports of committees for the term ending Dec. 31, 1876, contain some significant passages. We quote from Mr. Roberts' report on Ornithology:

"I have thought that probably the best course to pursue in preparing this, the first, report would be to begin as far back in the history of the Ornithology of Minnesota as my knowledge would permit, and rapidly review the different articles, on this subject, that have appeared up to the present time. As it has been but a few years, comparatively, since this country was explored and settled, the ornithological literature relating to it is not very voluminous."

The larger part of this report is devoted to a comprehensive and critical digest of this literature, concluding with this passage.

"A number of species are yet to be added, as ultimately three hundred (300) forms and perhaps more will undoubtedly be found in the state. Here is work not for two or three but for many, and as the list increases the work becomes harder and the results less than when it is small. But the greater the achievement if a new species be added after the field has been thoroughly worked. Moreover the making out of lists is Only a portion of the work. It is necessary that a long period of time be devoted to a careful study of the habits at different seasons of the year; dates of arrival and departure; time, place, and circumstances attending the breeding; relative abundance during successive years; &c, &c. of each species, in order that we may have a complete history of the avi-fauna alone. So it is evident that we have a vast amount of work before us which will much more than occupy all the time we can devote to it."

Sixty-five years have elapsed since this ambitious program of real natural history was laid down, and during the whole of this period Dr. Roberts has devoted himself to its consummation so purposefully, persistently and skilfully as to win recognition as one of the leading ornithologists of this continent.

Mr. Williams' report on Botany also summarizes the scanty literature of the flora of Minnesota and reports progress in the compilation of a list for the vicinity of Minneapolis.

"The beginning of such a list has already been made in the society, and considering the comparative short time that the society has existed and the few who have taken hold of this matter, more has been accomplished by this society, probably, than by any other in the state. To make a complete list must require a person well acquainted with botany as there are, without doubt, many new varieties and some new species to be found here not before described. Thus it remains for some one to distinguish himself by identifying these."

Mr. Williams did not achieve this distinction, but he did win first rank in another and a larger field as our leading authority on the mosses.

In Mr. Herrick's report on entomology he says,

"The points which have begun to attract general attention of late are those respecting geographical distribution and some particular variations in minor characteristics, such as color, considered in relation to preservation and propogation of specific differences. In a word those particulars which bear most directly upon the theories of mutability of species and their derivation have in entomology, as in other branches, received more general attention."

In the following pages there is evidence of careful reading of the current works of Darwin, Wallace and Packard and of correspondence with Dr. Packard regarding evidence that various stages of one insect have been described as members of different genera.

The report on Geology and Mineralogy by by Mr. F. S. Griswold opens with the statement, "Little has been done by the members of the Society, collectively or individually, in this line, with the exception of Mr. Herrick, who deserves

great credit for his perseverence in working up the fossils of the Trenton Limestone." Then follow recommendations for enlarging and systematizing the collections and summaries of Professor Winchell's reports on the stratigraphy of the state in relation to waterpower, glaciation, etc., and other recent literature.

In March, 1878, a report was submitted to Dr. P. L. Hatch, state ornithologist, by Roberts, Williams and Herrick, an "exact copy" of which is among the papers of the Young Naturalists' Society. This is a remarkable document to come from the hands of youths of about twenty years. There is a record of one species new to the state and detailed field notes on the rare Leconte's bunting, Coturniculus lecontei. These and similar notes on several other species show that the uncommon capacity for acute and critical observation which characterized these three naturalists in later life was already mature. This unpublished report is really an addendum to Mr. Herrick's report to Professor Winchell dated December, 1876, and published under the title "Ornithological Notes" in the Fifth Annual Report of the Geological and Natural History Survey of Minnesota, for the year 1876.

The list of birds assembled by the Young Naturalists' Society ultimately grew to several hundred, as indicated by a passage in Professor Winchell's Annual Report of the Survey for the year 1883, where on page 10 we read, "A list of about 500 species, observed chiefly in the vicinity of Minneapolis by the Young Naturalists' Club, was communicated by Mr. Thomas S. Roberts, by whom nearly all of these species were determined, others by Clarence L. Herrick, F. S. Griswold, and R. S. Williams." Dr. Roberts informs me that the number 500 is much too large, for there are now about 326 species and subspecies of birds recorded in Minnesota.

Of all the documents preserved the most illuminating are the fourteen original papers. These were written in 1875 or early in 1876, the first year of the society's life. The five by Frank Ham are humorous yet rather pathetic examples of the reactions of an earnest but slow-witted farmer's boy to the stimulation of his more alert classmates. Frank was not one of the shining lights of the society and his membership lapsed at the close of the first year. Yet his brief papers on "Bees," "The Bee Moth," "Spidars," and "Poplars and Willows" show a commendable effort to canalize the routine experience on the farm into channels of scientific interest. The observations recorded were original (for him), though not new to science. The paper entitled "Promiscous" shows the true scientific spirit of inquiry. The question arose in his mind whether plants move toward the sun principally for heat or for light. The problem was solved by a simple set-up of experimental conditions found ready to hand in the farm kitchen. A box of growing cabbage plants placed between the stove and the window turned toward the window. "Now you see that my question is answered unless there is a difference between the heat of the sun and artificial heat."

Another question suggested by the daily chores was, "do animals which make their abode in decaying vegetation have pure arterial blood. I have had special oppertunity to examine the minure heap this week." The opportunity was improved by inspection of the life habits of the fauna of the manure pile, but the conclusions reached were not regarded as very reliable.

Frank reappeared on the scene several years later when my brother Clarence was teaching a summer course in biology at the university. As he related it to me afterwards, before the first laboratory exercise the class was told

exactly what equipment of dissecting instruments, etc., each student was to bring to the laboratory. On that first day grasshoppers were to be dissected. As Clarence made the rounds, here was Frank with a grasshopper in one clumsy hand and a huge farmer's jacknife in the other.

"Frank, where are your dissecting instruments?"

"I didn't bring any. You see, Mr. Herrick, I only want to get a general idea of the insect."

This recalls to my mind another story which Clarence told me about Agassiz. On a field trip with a group of Harvard boys an unfamiliar dragonfly darted past the party. One of the boys who was sent in pursuit presently returned panting, with the cheerful word,

"Here, Prof., is your darning needle."

Such levity ruffled the equanimity of a Boston clergyman of the party, whose reprimand took the form of the question,

"Professor Agassiz, what is the proper botanical appellation of this insect?"

It may be that Frank Ham's attitude was more hopeful. It is better to get a general idea of an insect or anything else directly from nature than to accumulate any number of proper botanical appellations.

The two papers by Robert S. Williams on "The Canary Bird" and "The Motory and Alimentary Apparatuses" are excellent school-boy essays containing some personal observations. In the second paper, starting with rotifers and Cyclops, he comments on their transparency and the opportunity thus given for observation of the inner economy. Then follows a discussion with illustrations of ways in which these two systems of organs are used in the scheme of classification of animals.

The seven papers by C. L. Herrick are of very unequal merit. The essay on "Electricity" is, as might be expected, a discussion and criticism of rival theories. "The Skin and its Appendages" is a compilation of diverse facts and homologies. The brief notes on "The American Cockoos" and "The Night Hawk" are records of personal observation. Under "Stray Hints" we find a manual of simple instructions for collecting and preserving various sorts of natural history specimens. One of these papers is Part First of the President's Address on "Classification." In the introduction he raises the question, Why should those who do not expect to earn a living by teaching science or writing books about it devote long, fatiguing hours to its study?

"We must look for the answer partly in ourselves. We are conscious of a good result to ourselves from such study, we are also conscious of great pleasure in the study itself and can only account for it by supposing that there is an inherent desire in us that is met by this occupation."

Here Clarence, at seventeen years of age, stated the principle of the primary motivation of scientific research as clearly as it has ever been done before or since. In the discussion of principles of classification he follows Agassiz, and here perhaps he showed less keen insight. For in the application of these principles he immediately finds himself in difficulties which were clearly recognized. The remaining parts of this address are lost, so we do not know the outcome.

The paper entitled "Embryo of Common Fowl" was read on June 18, 1877, recounting observations made and recorded with many drawings about a year before. The young naturalist here repeats the observations of the early embryologists, and apparently he had at his command scarcely more background of previously recorded knowledge than had Aristotle. The eggs were removed

from the nest on successive days and opened. Everything visible in the living condition was described minutely. On the fourth day the pulsating heart and the vitelline veins and arteries are described. Then he says, "returning to the embryo itself we see that it bears no resemblance to a hen or, indeed, to a bird of any sort. It resembles perhaps most nearly a lizard with a long coiled tail and two large eyes occupying a large portion of the head."

The best of Clarence's work is evidently not represented in these seven papers, except perhaps the one last mentioned. Among the papers there are two plates containing twenty-two neat pencil drawings of insects which were "presented to The Young Naturalists," obviously illustrating a paper which is not preserved. His reports on lists of birds, insects, plants, fossils and microscopic crustaceans are not in the files, but their substance is doubtless incorporated in subsequently published papers.

II

Though the organized life of this society was short, its influence survives. Of the subsequent lives of some of the members little is known. One of them, Clarence S. Lum, became a lawyer of note, practicing at Duluth. The careers of the three promoters and most efficient members of the society may be regarded as the natural fruitage of a growth whose seed-time and early cultural stages are here recorded. Two of them are still actively exemplifying the worth and dignity of natural history in its classical form—the study of life as it is lived in the open.

Robert Statham Williams was born in Minneapolis on May 6, 1859. He attended the high school and before graduation entered the University of Minnesota as a subfreshman. He was active throughout the life of the Young Naturalists' Society, and in 1876–77 he was chairman of the society's Committee on Botany.

In 1879 Mr. Williams went to the Far West, where he had varied and picturesque experiences as sheep herder, rural mail carrier and other activities in Montana and fur trader in Alaska. Throughout this period he maintained his interest in natural history. In a letter which he wrote to Thomas Roberts from Martinsdale, Montana Territory, December 5, 1879, he recounts some experiences in the saddle while carrying the United States mail and includes some observations and queries about the birds of Montana. Another letter from Montana three and a half years later shows some activity in ornithology. His interest turned to the western flora and he began sending specimens to Professor Eaton of Yale, who encouraged him to collect mosses in particular. He then went to South America and collected mosses in the Andes, where he contracted fever and nearly died. Since 1899 he has been connected with the New York Botanical Garden, Bronx Park, as research associate in bryology, and has recently returned to Minneapolis.

Advancing from the status of collector to that of taxonomist, Mr. Williams rose to the rank of our leading authority on the mosses. His first scientific paper in this field, describing two new Montana mosses, appeared in the *Bulletin* of the Torrey Botanical Club in 1902. This was followed by about 55 papers in which 165 new species and 9 new genera were described. More comprehensive studies were published in Part 2 of Volume 15 of the North American Flora. Many species described by others bear his name, and one genus. Regarding the latter, Mr. Williams writes me:

> The moss at present known as Williamsiella tricolor (Williams) E. G. Britton—see Bryol-

ogist, vol. 12, p. 62, 1909 — has something of a history. Brotherus, not having seen Williamsia used before as a generic name, considered Syrrhopodon tricolor Williams as not a Syrrhopodon, but as belonging to a new genus which he called Williamsia tricolor. Mrs. Britton noting this, promptly changed the name to Williamsiella as Williamsia was, a year or two before, used for a tree growing well up on Mt. Apo in the Philippines, which I collected. In my trips I have always collected more flowering plants than mosses, and quite a good many have been named after me among the many new species collected.

Thomas Sadler Roberts was born on a farm near Philadelphia, on February 16, 1858. He came to Minneapolis in 1867 and entered the high school there in 1874, graduating in 1877. In the autumn of that year he entered the University of Minnesota and in 1882 he entered the Medical School of the University of Pennsylvania, from which he received the M.D. degree in 1885. After interning in Philadelphia he returned to Minneapolis in the fall of 1886 and entered practice.

In 1879 he was a member of a field party of the Minnesota Geological and Natural History Survey, collecting birds and plants on the north shore of Lake Superior, and during the four following summers he was a member of land surveying parties of the old St. Paul, Minneapolis and Manitoba and Northern Pacific railroads in Minnesota, Dakota and Montana. Here he gained much information about the birds of the regions visited.

He was professor of pediatrics in the University of Minnesota from 1901, becoming emeritus in 1913. Throughout the period from 1874 to 1913 ornithology was his avocation and he has been state ornithologist since 1890. He has been professor of ornithology, curator and later (1919) director of the Museum of Natural History of the University of Minnesota since 1915. During 1939 a large and beautifully appointed new museum building was constructed and Dr. Roberts was fully occupied with plans, supervision and the transfer of the collections.

Despite the exactions of a large medical practice and important teaching and administrative duties, Dr. Roberts has maintained a high level of scientific production. His published works include about 7 medical papers, 200 on natural history subjects and 4 books. His beautifully illustrated "Birds of Minnesota"[1] is one of the classics and was so recognized by the award of the Brewster Medal by the American Ornithological Union "for the most meritorious work on American Birds." His recently published "Logbook of Minnesota Bird Life"[2] contains bimonthly season reports for a period of twenty years, with meteorological and other natural history notes, the whole interpreted and spiced by sixty-six years of continuous field observation of living birds.

Clarence Luther Herrick was born in Minneapolis on June 22, 1858. During his childhood his father was pastor of several small churches and from 1866 to 1871 of the First Free Baptist Church of Minneapolis, from which he retired because of poor health to the small farm outside the city where most of Clarence's childhood was spent. Here Clarence grew up a solitary child and very early showed that spontaneous interest in all

[1] Thos. S. Roberts. "The Birds of Minnesota," 2 vols., with 92 colored plates. University of Minnesota Press, 1932, revised edition, 1936.

[2] Thos. S. Roberts. "Logbook of Minnesota Bird Life." University of Minnesota Press, 1939. The records of all ornithological observations made by the Young Naturalists' Society are incorporated in this work or in Dr. Roberts' "Birds of Minnesota." In the latter work (1932, vol. 1, p. 6) he gives a brief account of the "Young Naturalists" and refers to the annotated lists of birds and plants prepared by the society.

natural things which continued to be the dominant motivation of his life. His father, a frontier preacher without professional training in divinity and largely self-taught, was a man of rare insight and tolerance. Among my own early recollections are conversations between him and my older brother about the religious significance of Darwinian evolution. There was little money in the household in those days, but always there were magazines and books from the public library.

Diligent search through the family annals reveals nothing in the records or traditions of either paternal or maternal ancestry suggestive of scientific aptitude or interest. They were rugged, efficient practical folk and Clarence's paternal grandfather, Nathan Herrick, was a pioneer, emigrating from Vermont to the Mississippi Valley in 1854. To all superficial appearances his father, Henry Nathan Herrick, was no more scientifically inclined than the others, yet some of his characteristics suggest the presence of genes which, transmitted to Clarence and there rearranged in new combinations, brought forth a born naturalist.

Clarence had native talent in art and music and a philosophic mind. He was trained as an all-'round field naturalist in the best tradition of that school, a school of "natural philosophy" which takes all nature as its province, seeks personal experience in every domain of it, and attempts to rationalize all these experiences into a coherent whole. He was equally at home in field and laboratory, and the short span of thirty years of his active career covered the period of transition from field study to laboratory and experimental procedures which characterized his time and which he exemplified in his own person. In later life he specialized, and in a field which preeminently requires experience and insight within a horizon which embraces all knowledge and all human achievement.

Clarence attended the Minneapolis high school for one year, then transferred to the preparatory department of the State University and soon thereafter became Professor Winchell's assistant in the State Geological and Natural History Survey. His connection with the Survey was maintained until he left Minnesota in 1885, save for the year 1881–82 spent in German universities and the autumn quarter of 1884 spent at Denison University. In the autumn of 1885 he entered upon his duties as professor of geology and natural history at Denison, where he remained until 1888. He was professor at the University of Cincinnati from 1888 to 1891, visited Europe in 1891–92, and in the latter year returned to Denison, where he remained until 1894. In December, 1893, an acute attack of pulmonary tuberculosis nearly took his life and the following ten years were spent in the far Southwest in a losing battle to regain his health. During this period he was president of the University of New Mexico from 1897 to 1901. He died at Socorro, New Mexico, on September 15, 1904.

My brother Clarence was a naturalist in the proper sense of the term throughout his life, whether engaged in field survey, teaching, laboratory work or philosophic writing. The most productive period of his life was spent in his native Middle West. He stuck to his business as teacher and investigator with few outside contacts or interests. As a teacher he was preeminent and, though the number of his pupils was never large, his stimulating influence directed a surprisingly large proportion of these into successful careers in various fields of scientific work. His most notable monuments, aside from the inspiring influence transmitted to his students and

colleagues, are the two journals which he founded—the *Bulletin* of the Scientific Laboratories of Denison University, now in its 36th volume, and the *Journal of Comparative Neurology,* established at Cincinnati in 1891 and now in its 76th volume. Near the time of his death a brief biographical notice appeared in the *Journal of Comparative Neurology* (Vol. 14, November, 1904), accompanied by a portrait and a bibliography of 135 titles of scientific works and to this list about ten others can now be added. Testimonials to his character and scientific insight have recently been published in the Fiftieth Anniversary Volume of the *Journal of Comparative Neurology,* 1941.

That their experience in the Young Naturalists' Society profoundly influenced the subsequent careers of its three promoters is evident. Dr. Roberts' whole life is a realization of the ideal program which he formulated as chairman of the committee on ornithology of the society, already quoted. The letters and published works of Robert S. Williams give similar testimony in his case. In a letter to Dr. Roberts dated October 27, 1887, C. L. Herrick wrote from Denison University:

> We are progressing rapidly here. A new scientific building and museum are to be soon put up at an expense of 25–30,000. dollars. This will enable me to put in existence certain schemes entertained as long ago as when a member of the Young Naturalists' Club. . . . The school is growing in other lines also. The students are organized into a Denison Scientific Association, several of the features of which were suggested by our old experience as Y. N. Society.

III

These records of the juvenile activities of three successful naturalists reveal that the essential factor in the development of the research methods characteristic of each of these men was the inherent quality of his own native endowment. They also demonstrate that their personal idiosyncrasies and interests were woven into the fabric of the scientific structure which each of them finally built out of such materials as were available. The details of the pattern of this structure were shaped by their daily contacts with one another, by their cultural environment—the university in particular—and by the natural configuration of the terrain within which they grew up. But the fundamental design of the structure was determined by none of these environmental influences; it was in each case an expression of the inner nature of the man.

Each of them participated in all phases of the society's activities, yet his own distinctive qualities were manifest from the start. The dating of the founding of their society is important—at the beginning of the high-school course, not at its close. The high-school years are formative, but under the direction of severe mental regimentation. This enterprise was conceived spontaneously and elaborated in detail under no external influence whatever so far as can be learned.

These children began to play with natural history, not because they had nothing else to play with, but, as the Nobel laureate Michelson later expressed it, because "it is such corking good fun." Having no one else to teach them, they taught themselves. They fumbled along, ineptly at first, but not blindly, learning by their own mistakes. Soon they found guidance in books, later in men, and they learned how to use both; but they followed nobody; each developed his own method and shaped his own career.

The scientific output of each of these men carries the stamp of the interest and aptitude of its designer as truly as does that of the artist. And these personal values can no more be filtered out from the one than from the other. It

is a whole man who describes a new species of bird or paints a distinctive portrait, not a denatured intellect in the one case or a dissundered aestheticism in the other.

Science has been so preoccupied with "analysis and ever more analysis" as too often to ignore the essential integrity of the things analyzed, and to forget that the fragments left in our hands after analytic dissection are, as such, fit only for the scrap-heap. These fragments which we have artificially separated by physical manipulation or logical processes must be reassembled, perhaps in new and more instructive patterns, or our analytic labors are wasted. Both the analysis and the ensuing synthesis are accomplished by human industry and ingenuity and they carry the stamp of the agent who does the work. The scientific generalization finally made is believed to be true, but it is not and can not hope to be a flawless reflection of the order of nature. We do the best we can with the knowledge and insight available, but we must never lose sight of what Campion calls "the errorful subjectivity of human knowledge."

Natural science can be neither understood nor evaluated apart from the qualities of the men who made it and the physical and social milieu within which they did it. Any attempt to tear these components out of the scientific fabric eliminates factors which are essential for evaluation of the data and in the realm of the social sciences destroys the data themselves, for human values are the vital factors here. Do not overlook the fact that the structural body of all natural science is itself a part of that nature which it is the naturalist's business to explore. As a human achievement it has a natural history of its own, for this body of knowledge is the natural progeny of the people who generate it.

WAR PROBLEMS OF THE PHYSICS TEACHER[1]

By Dr. ARTHUR H. COMPTON

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In presenting to-day the first Richtmyer Memorial Lecture we are doing honor to a physicist who was more than a physicist. He trained men who are now among the nation's leaders. His teaching enabled his students to acquire the technique of exact thinking. He had that breadth of vision which helped both his students and his colleagues to understand the setting of their scientific labors and to form intelligent objectives as their goal. He thus helped to lay the foundation of a strong society.

Those of us who had the pleasure of working with Richtmyer learned to admire the straightforwardness of his thinking, the courage with which he attacked new problems and his reliability, which gave us confidence that tasks assigned to him would be well done.

To-day we have before us, as physics teachers, problems which are presented by the war. Some of these problems are new, others old. Richtmyer was a leader among those physicists who were concerned with the best use of our science in strengthening the nation. He knew that without the technical knowledge supplied by physics neither our industries nor our defenses could compete in the modern world. He was himself one of those far-seeing men who at the close of the last war encouraged the training in this country of a large and capable group of young scientists. Before his generation, though a few American physicists were doing good work, we were far behind our European contemporaries with regard to the number of well-trained young men. In the development of modern physical theories, the United States had played a meager part. It was the vision and encouragement of such men as Richtmyer that brought large numbers of our best students into the fascinating studies of radiation and atoms, the result of which has been to give the supply of skilled men and women which is now our greatest source of national strength.

[1] First Richtmyer Memorial Lecture, presented before the American Association of Physics Teachers and the American Physical Society, at Princeton, December 30, 1941.

The Physics Teacher's War Problems

What are the distinctive problems with which the physics teacher is now faced? Let me mention a few. (1) Should we encourage our students to keep at the study of physics? (2) In teaching our students, how should the content of our courses be altered to meet the present emergency? (3) How can our methods of presentation best be adapted to present needs? (4) In a day when physics research is essential to the national defense, what should be the relative emphasis in our own work between our teaching and our technical investigations?

The broader problems also are insistent. How can physics best aid in building the nation's strength? What will be our situation when the war is over? Will our science continue to mold the development of society during the next generation as it has in the past? Let us consider these questions in order.

Should Students Study Physics in Time of War?

I believe the statement that in this war a hundred physicists are worth a million soldiers originated in England, when it was found how important the physicists

were in meeting the threat of magnetic mines, of night bombers and of submarines. This striking statement on calm reflection is hardly exaggerated. It applies especially to our American war effort, where at present our greatest contribution is in developing new devices for defense and offense and in supplying war materials that must be equal or superior to those used by enemies. If there is a threat of shortage of rubber, there is already an acute shortage of physicists. Thus nothing is more important in maintaining and building our military strength than the supply of an increasing number of well-trained physicists.

Emphasis on this point is being continually made in a series of editorials and articles in the *American Journal of Physics*. It is of first importance that attention to this need be kept before the students of physics, who are apt to become restless because of their desire to be of active service. It is of equal importance that our draft boards be kept aware of this situation, in order that our young men can be assigned to tasks in which their distinctive qualifications are useful.

In support of this view of the nation's need for physicists, let me refer merely to President Conant's report of the development of the Selective Service in Britain. He states that while from the beginning of the war men with scientific training were in a favored position, after the first year had elapsed, two groups, the physics and the medical students, were the only ones who were completely exempted from direct military training. This was because their professional service was so urgently needed that no time could be lost in completing their professional studies. It has become evident in the United States that a similar acute shortage of physicists is now beginning to show itself.

This, of course, does not mean that all persons who wish to study physics should be encouraged to go ahead. It is as true now as ever that it is the superior ones who can make the important contributions. This is especially true in the research field. There is, however, also the need for men and women having practical familiarity with physical instruments to do the laboratory and field tasks. These need not always be of the top rank. But we can not afford to train numbers of inferior students at a time when our training resources are being strained. It thus becomes especially important for us to draw into the physics fold the most capable available young men and young women, and to weed out those whose promise is so low that their special training will be of little value to the nation's strength. Our college students should thus know of the nation's urgent need for high-quality physicists, even though in view of the growing shortage of physics teachers, we may need to enforce a stricter selection.

What Courses Should We Offer?

The answer to this question is that we need persons with all degrees of training. It is true, as it has always been, that the most valuable scientific men are those with thorough technical training combined with a broad knowledge of the relation of science to technology. Persons of these qualifications are, however, necessarily rare. We must remember that in many cases special training in particular fields of physics may considerably increase the value of persons who may be engaged upon defense tasks.

Among the special fields in which we are asked to train our students have been those of the fundamentals of aviation in connection with the Civilian Pilot training, radio courses and meteorology. In these fields there are immediate applications. The present trend is apparently for more and more of the aviation training to be done directly by the Army.

The more complete meteorology courses have been concentrated in a few centers, though there remains a place in every college for introductory studies in this field. There would seem to be no adequate alternative, however, to the college training in the understanding and use of radio circuits. The demand for proficiency in such work must necessarily increase.

It remains true, however, as it has always been, that it is the fundamentals of physics which must form the basis of our instruction program. Without a thorough grounding we can supply to the nation only a half-baked group of physicists and eventually not only the students themselves but the nation as a whole will suffer. It may be complained that time is too short for such thorough training. To this the answer is that our struggle is not one of a year or two years, it is a struggle of a generation. At the moment we must rely upon those already trained for our scientific leadership. If, however, a continual supply of fully trained men is not available, it is inevitable that, as a nation, we shall decline.

In the preface to his book, "Introduction to Modern Physics," F. K. Richtmyer presented his view of the importance of a thorough understanding of the background of physics.

> The author (in his teaching of physics) has attempted to present such a discussion of the origin, development, and present status of some of the more important concepts of physics, classical as well as modern, as will give to the student a correct perspective of the growth and present trend of physics as a whole. Such a perspective is a necessary basis—so the author, at least, believes—for a more intensive study of any of the various subdivisions of the subject. An account of modern physics which gives the *origin* of current theories is likely to be quite as interesting and valuable as is a categorical statement of the theories themselves. Indeed, in all branches of human knowledge the "why" is an absolutely indispensable accompaniment to the "what." "Why?" is the proverbial question of childhood. "Why?" inquires the thoughtful student in classroom or lecture hall. "Why?" demands the venerable scientist when listening to an exposition of views held by a colleague.

It is only upon those with this thorough grounding in why things happen that we can rely for our future scientific leadership. Rather than to omit such thorough studies, should not the effort be made rather to encourage our students to redouble their efforts to complete their college and graduate training as rapidly as is consistent with thoroughness?

New Methods of Presentation

There never was a time that called for more skill and care in teaching than now when the student's and teacher's time is precious. Presentation of our material in a form that can be clearly and quickly grasped is our part of the common task. Fortunately, the increasing familiarity of our students with mechanical and electrical devices is a help. The importance of physics in the war is likewise an asset in favor of the student's interest. We can call attention to the fact that success in his task is essential if a student would play his part in the national war effort, and that such success is measured by his classroom achievement.

The war supplies us with many devices that illustrate the principles of physics. It is clear that we shall want to make good use of these examples.

Teaching versus Research

Each of us at this time is asking himself, "At what task will my effort count for most?" Many who have been in our classrooms have become research physicists or engineers or physicians, who in their everyday service make use of what we have taught. To others, our instruction has, we hope, opened a broader understanding of the world and an appreciation of the scientific method of

thought. Through all these students, the physics teacher can pride himself that he has contributed to the nation's strength. There is, however, the natural yearning by each of us to do something directly, and a dissatisfaction with what seems to be a routine job.

Is not the answer to this problem that in whatever physics task we find ourselves engaged, we can be confident that we are contributing to the total strength of the nation? We want, naturally, to assure ourselves that our task is an essential one; but who would say that the physicist who develops an important application of electric waves that may be useful in war communication, is performing a more valuable function than the man who trains the physicist who can do this and a thousand other tasks. Some physics teachers will be qualified for specific problems of research. They are fortunate. We shall give them all possible aid. If they are, however, drawn from their classrooms, their places will need to be filled by others who may have different specialties. All of us will need to work at maximum capacity.

Physics and the Nation's Strength

Before this group it is not necessary to elaborate upon the many ways in which physics can be applied to the national defense. The demand for more physicists speaks for itself. Others can tell better than I what is being done. Much of the story must wait until the war is over.

Let me note, however, that urgent as is the present emergency, our task is to strengthen the nation for many years to come. We are confident of victory; but win or lose, the struggle will continue for decades, perhaps generations. For rival ideas, as well as rival armies, are at war. Defeat of the Axis armies will not mean that the national gods are destroyed, that nations will no longer seek prosperity by trying to enslave their neighbors. It will remain necessary for those who work for human welfare to demonstrate that in a free society useful knowledge can grow and can be directed to the common good.

The vaunted efficiency of the totalitarian régime has at least supplied us with an example of how not to prepare for the future. In 1939, before the war, in their concentration of effort on building a war machine, Hitler's Germany virtually eliminated theoretical physics from university instruction, because it was useless for the country's fighting power. The number of students of technical physics had fallen to a fourth of its peacetime level, because of the demand for military service. Already at that time the shortage of technical men was felt, and training was retarded. One can hardly imagine that this deficiency has been rectified in the last two years. The result is inevitably a future Germany that will be at a disadvantage in technology when compared with its neighbors, unless after the war technically qualified men should be imported on a large scale.

By contrast, it is clear that if America wishes to maintain leadership in a society based on technology, the continued and increased training of physicists is essential. In time of meat shortage we must grow more cattle, not kill off those we have. When physicists are scarce we must intensify our training program. Those of us who remain in the colleges must perforce do double duty; but it will be a national calamity if our numbers are so greatly reduced that adequate teaching can not be carried on.

What Lies Ahead for Physics?

The students that we train ask us, "What of our future?" They remember the depression, when physicists were unwanted. Now they see an intense demand. Some will be employed in the

war, but many can not expect to complete their preparation before the war is over. Then what?

You will recall that after World War I our universities doubled their enrolment. This was because the value of education had made itself evident to all the young men who were in the fighting. Chemical industries, newly established to meet the stoppage of German exports, drew thousands of young men. The close of that war meant the beginning of a new opportunity for America's chemists and engineers.

How then after the present war? President Conant, himself a chemist, remarks that this is the physicist's war. Never before has physics been in so favorable a position to demonstrate its effectiveness—and the demonstration is impressive. The outcome of this work must necessarily be the introduction of more physical techniques in industry. Leaders in the current developments will be found in high places. As chemists in industry now seek young chemists to do new jobs, so as more physicists assume leading industrial positions, we may expect more young physicists to be called for. At the moment, at least, the trend is toward further emphasis on the physicists role.

There is, of course, the possibility—some say the inevitability—of a post-war depression. If this should occur, my guess would still be that the physicist will feel such a depression less than those in other professions, for the reason just given, that our work is playing a rapidly growing part in the nation's life.

Professor Sarton tells how the continual growth of science forms the main line of man's gradual development toward more complete humanity. The growth of physics through which we are living, is a clear example. We learn the laws of heat and of electricity, and steam and electric power transform our world. We discover electrons, and the radio broadens our outlook. Nuclear physics takes its place and dreams of a life based on atomic power arise ever more clearly before us.

To make use of these developments, society has to become more highly organized. We depend upon each other more and more as our work grows more specialized. Willingness to work together is needed in the new society. Modern physics thus forces man to become more completely a social being.

It is a corollary that disorganization creates greater havoc than in a pre-technical society. Our national strength grows greatly as we unify ourselves to meet a threat from without; but a world disorganized by war can not function smoothly, and all mankind suffers. The science which leads toward a unified world thus makes war a greater disaster. It is such a threat that must make men learn to solve their problem without war.

According to ancient legend, Daedalus with his newly invented forge fashioned a steel sword which he presented to King Minos. "Alas," said the people, "this sword will bring us not happiness, but strife." " 'Tis not my purpose to make you happy," replied Daedalus, "but to make you great."

Thus it is that physics, giving vast new powers to man, is challenging him to shape his world on a more heroic scale. It is great to be a physicist in days like these. God grant that men may learn to use wisely the mighty sword that Daedalus gives.

BOOKS ON SCIENCE FOR THE LAYMAN

THE PROGRESS OF MEDICINE[1]

THAT there should be a steady and insistent demand from the laity for books on medical topics is not strange; every one has a body, and has a vital interest in knowing how it functions and how disease may be avoided. All too often writers take advantage of this interest to palm off inaccuracy, one-sidedness or downright quackery on an unsuspecting public, to the dismay and chagrin of the medical profession and to the confusion of the laity. When, therefore, a thorough, accurate and readable book on medicine appears, there is cause indeed for rejoicing.

Mr. Gray is an experienced writer on scientific matters. He grasps the subject, learns the details and then presents it in such a way as to hold the attention and make the facts clear. To quote the author: "This book is not a compendium of medical lore, or a guide to modern research, or a treatise on cures. It is simply an effort to convey an impression of what medicine is trying to do, of the standards and procedures with which it works, and of the achievements, the problems, that are engaging the attention of the men of the laboratories and those in the clinics." The three main fronts along which medicine has advanced in this century, says Gray, are infectious diseases, endocrine (ductless gland) disorders and nutritional deficiencies. We find, of course, a chapter on vitamins ("The Five Aliments") and one on sulfanilamide, that almost magical drug. Two are devoted to the constitution and diseases of the blood ("The Sea We Live in" and "Bleeders and Clotters"), two to mental disorder ("Anxiety" and "Brain Storms"), one to cancer, one to alcoholism and one to the effects of tobacco smoking. The physiology of sleep is discussed, as are the nature of pain and the process of aging.

In the preparation of each chapter, Gray consulted the leading specialists in the field and studied the literature carefully. Chapter and verse, or at least the book, are given for nearly every statement, but not in pedantic footnote form. The fact that differing views are held on some topics is not blinked by the author; he does not oversimplify, and he avoids dogmatism, that bane of the scientist. His fine sense of balance is indicated in his closing chapter:

"Health does not fall like the gentle rain from heaven—not in our complex civilization of speeding motors, invisible viruses and other germs, highly sensitized tissues, dysrhythmic brain waves, disordered body chemistry, and the constant fear of 'what will people say?' When to these ingredients you add slums, idleness, vice and finally the ultimate flowering of human stupidity, war, you arrive at a recipe for disease that is universal. It can produce anything listed in the pathology books—and does.

"The public health movement has demonstrated that cities, states and nations can lower their disease rate and lower their death rate by taking thought of the preventive measures against disease and taking action to enforce them. The same principle applies to the individual."

To every one who desires a survey of the advances made by medicine, with all that they signify for health and happiness, the volume can be heartily recommended as sound, comprehensive and balanced. Mr. Gray has rendered a valuable service to medicine and to intelligent readers.

WINFRED OVERHOLSER, M.D.

[1] *The Advancing Front of Medicine*. George W. Gray. viii + 425 pp. $3.00. November, 1941. Whittlesey House.

BRAIN STORMS[1]

THE older conventional conception of mind and matter as two distinct entities almost unrelated to each other has given way to recognition that "mind" is a functional expression of the organic structure of the brain. The demonstration in 1929, by Hans Berger, a German psychiatrist, that enormous amplification of the electrical currents of the brain makes possible the detection of these currents and the recording of the various impulses, has stimulated much research into this field. The pattern of electroencephalographic tracings has been found to be fairly characteristic for each individual, and certain mental and/or nervous disorders likewise give rise to changes in these patterns which are of considerable diagnostic value. As is true on the appearance of any and every new instrument of precision, there has been more enthusiasm in the application of the new technique than judgment in the interpretation of the observations. Though much has been learned concerning the significance and mechanisms of these "brain waves," far more factual information is necessary before their interpretation is scientifically sound. This spearhead in the advance of science has not yet "consolidated its gains."

The electroencephalogram has been applied most extensively to the study of epilepsy. In the detection of asymptomatic or "potential" epilepsy the method is of proven clinical value and is of great service in aiding in the selection of candidates for training as air pilots. Dr. William G. Lennox, of the Harvard Medical School, has for many years been interested in epilepsy, and now in a new and most interesting book attempts to explain to the layman the phenomena of this disease. In attempting this Dr. Lennox is very brave and ambitious, but one questions his wisdom. The subject is so ill understood by even the most advanced students thereof, it is so extremely technical and requires such an extensive foundation knowledge of psychiatry, the anatomy, physiology and chemistry of the brain and involves so many diverse and variable etiologic factors that the layman is much more likely to be confused than soundly instructed. The book is meant, apparently, for both popular and medical consumption. For the latter audience it is a stimulating monograph discussing theoretical and controversial concepts. The lay reader will be left puzzled or actually misled by the implications of specificity and finality of the Berger rhythms.

However, the severest criticism of this book, which is well written, interesting and full of thought-provoking concepts for the critical physician, professional psychologist or biophysicist, is that Dr. Lennox links migraine with epilepsy. Some fifty years ago Gower, the great English neurologist, stressed the association of the two disorders, pointing out that both have hereditary factors in their etiology, that both are paroxysmal in character and that the attacks of both are preceded by aura or subjective warnings. But there the associations stop. Migraine is a functional disorder of the vegetative or sympathetic nervous system; epilepsy is a disease of the brain. Epilepsy ultimately leads to mental deterioration; migraine, on the contrary, is far more frequent among those with especially effective minds. The reviewer has yet to meet a stupid migrainic, although he has seen many with untrained minds as well as many more with truly brilliant intellects. Epilepsy is progressive; migraine is not. There are many more wide and significant differences which make the association of the two disorders scientifically unsound. It would be equally logical to associate hay-fever with epilepsy, for in many individuals the migrainic attack is an expression of an allergic reaction. To relate migraine and epilepsy in the

[1] *Science and Seizures.* William G. Lennox. Illustrated. xiii + 258 pp. $2.00. 1941. Harper and Brothers.

lay reader's mind is not only wrong, but downright dangerous and destructive. Physicians know the incongruity of such association, but the lay reader, without clinical knowledge, is uncritical, unprotected and gullible. To encourage misleading the gullible is unwarranted, no matter how well the book may be written nor how stimulating are the theoretical hypotheses presented. The migrainic has a sufficiently heavy cross to bear with adding the damning and erroneous insinuation that his or her disorder is related to epilepsy and is a sign of constitutional inferiority. Just because the migrainic individual is more vulnerable to the effects of fatigue than are other types, is it logical to classify him as constitutionally inferior? A blond is more vulnerable to the actinic rays of sunlight, and blondness is hereditary. We can not, however, say that blondness is therefore related to a disease of the brain. The greatest obstacle to effective clinical management of migraine is the habitual discouragement of the patient as a result of repeated frustrations of ambition due to the susceptibility to fatigue. Nausea is the most discouraging symptom of them all. It is feared that by adding unwarranted discouragement the present volume will do more harm than good.

EDWARD J. STIEGLITZ

AN AMERICAN DOCTOR IN AFRICA[1]

AFTER two weeks on a river launch, the author traveled in canoes on streams walled by jungle "as monotonous as spinach," yet filled with variety and interest for such an observer as Davis, who found charm in everything—the rhythmic strokes of the paddles and the chants of the paddlers—"Oh, the white man sits back while the black man paddles."

He was going to the medical mission station to spend ten years as doctor for countless souls who would otherwise have no doctor at all, in an area the size of Connecticut. In his last year there, 65,000 patients came to the dispensary to be treated, and he himself performed 536 major operations. His patients had yaws, sleeping sickness, venereal diseases, leprosy, tropical ulcers, hernias, elephantiasis, abdominal tumors, goiters, broken bones, bladder stones and bad teeth. They were all infested with worms, intestinal or otherwise, and they got fish bones in their throats, were bitten by crocodiles and snakes, clawed by leopards, and cut up by each other. They suffered also from lice, from itch, indolence and indigestion—dirt, dysentery, dermatophytosis and the devil! Cancer, appendicitis, gall stones and typhoid fever he did not find. Usually the patients came after their own witch doctors had failed, and the cost of administering the magic needle with a dose of neosalvarsan for yaws was fifteen cents—providing the patient had the money. During spare time, inspection trips were made, usually by bicycle, to villages in the province.

The title, "Ten Years in the Congo," is unimpressive. Many people have lived there longer than that and learned less than Davis, and are less fitted to tell what they did learn. An ex-marine, tire salesman and student, he had had dreams of working his way around the world. Instead, he took a course in medicine for service in China, but *the girl* was located in Africa, and there he went.

A keen observer, as well as a hard worker, he has written of native life, the lives of the Belgian officials, in addition to his own work and that of his colleagues. He found time for an occasional hunting trip. He killed his elephant. His notes on the large creatures of the forest and the smaller ones of the household are interesting reading.

The author seems to know Africa and the Africans inside and out. His life in the jungle and his work, both of which he loved, make a delightful narrative.

W. M. MANN

[1] *Ten Years in the Congo.* W. E. Davis. xv+301 pp. $2.50. March, 1940. Reynal and Hitchcock.

THE BEHAVIOR OF TERNS[1]

POSSIBLY because of the social implications of colonial living and its parallel in human societies, the behavior of gregarious nesting birds has come very much to the front in recent studies. Another reason for this trend is undoubtedly the abundance of material within a colony: if one nest meets with disaster, the season's work is not lost, as there are many others for the observer to watch. Ralph Palmer's work on the common tern, here under review—is the latest instance of this type of study. The work was done in Maine, chiefly on the Sugarloaf Islands, near Popham Beach, Sagadahoc County, and the material was ample—about 750 pairs of common terns were nesting under his observant eyes.

By means of lettered or numbered stakes, individual nests were marked; by banding, by marking with quick-drying paint and by gluing bright feathers to their rumps, many birds were individualized for observational records. The actual observations were made from blinds at very close range, and the birds were disturbed as little as possible.

The first part of the report deals with the environment of a tern colony, the second with the behavior of the birds during the breeding cycle. The author finds that isolation is a primary requisite for a successful colony and that this is coupled with the need of an adjacent source of food (chiefly sand lances and small herring). From the behavioristic standpoint, it is necessary for the nesting birds to react as a unit and, accordingly, to see and hear their neighbors. Therefore, too high or too dense vegetation would act as a barrier to a colony. Even in successful colonies, the author estimates that not over 35 per cent. of the chicks that hatch survive until winter.

There are very narrow limits to the optimum environment of the common tern, which, like other species of terns, seems to be overspecialized, lacking the stability of gulls in the face of environmental change. The common tern is rigid in its behavior pattern, and it seems that most of the behavior exhibited is derived from two basic posturing positions. One of the functions of formalized display before the time of laying is to synchronize the breeding cycles of mates. They are not "in tune" from the beginning. Apparently the males are at least psychologically not ready to copulate, except for short periods, although the fact that males can be induced to do so after the loss of the first clutch would indicate that they may be physiologically ready to do so for a considerable period of time.

The whole report is of unusual interest and constitutes a real and important addition not only to our knowledge of the common tern, but to our understanding of bird behavior in general.

H. FRIEDMANN

[1] *A Behavior Study of the Common Tern.* Ralph S. Palmer. Illustrated. 119 pp. $1.00. 1941. The Boston Society of Natural History.

PSYCHIATRY FOR THE LAITY[1]

THIS little book of one hundred forty-eight pages is a psychiatric text-book written for the laity and quite free from technical terms. It is graphically illustrated and there are many simple examples and comparisons which remove a great deal of the mystery usually associated with mental illness.

The first few chapters of the book are devoted to an explanation of behavior and the reasons for particular types of behavior. The terms conscious and unconscious are defined and those particular periods of life during which mental illnesses tend to occur are discussed.

The last half of the book is devoted to a discussion of the types of behavior encountered in the psychoses, and their relation to normal behavior is carefully

[1] *Psychiatry for the Curious.* George H. Preston. x + 148 pp. $1.50. 1940. Farrar and Rinehart, Inc.

explained. The importance of early treatment is emphasized and the various forms of therapy employed in the treatment of mental diseases are explained.

This book is ingeniously written and very interesting. It is to be recommended to the medical profession as well as to the laity in general to whom it is especially directed. Furthermore, it is an excellent book to recommend to those of the general public who are confronted with the problem of mental illness in their families or friends.

EVELYN B. REICHENBACH

A CHRISTIAN LOOKS AT PSYCHIATRY[1]

THIS little book, written by the student counselor at Walla Walla College, offers an unsystematic discussion of various mental hygiene problems. Its orientation is Christian, its tone inspirational. Jesus is called "the greatest of the world's psychologists and mental hygienists" and His teachings "the standard and norm of mentality." While the author appears to have some knowledge of experimental psychology and a passing familiarity with various neurotic syndromes and their meaning, as escape mechanisms there is much that is outmoded and unsound. Thus there is a great deal of discussion about nerves "wearing out," "over-straining our nerves," and "nervous fatigue"; the progressive loss of intellectual ability with increasing age is denied; and the treatment of extroversion and introversion does not go beyond James's distinction between the "tough" and "tender" minded. There is nothing to indicate that the author has ever heard of psychoanalysis either as a theory contributing to our understanding of neurotic conflict or as a form of therapy. Scientifically weak and even fallacious though it is in spots, the book contains much homely, age-old wisdom about essential values and it may therefore help some, who can accept the religious frame of reference, to meet more serenely the conflicts and frustrations which confront them in everyday life.

ISABELLE V. KENDIG

[1] *How Your Mind Works. A Handbook of Mental Hygiene.* Gwynne Dalrymple. 160 pp. $1.25. 1940. Pacific Press Publishing Association.

FROM CANDLE TO FLUORESCENT LIGHT[1]

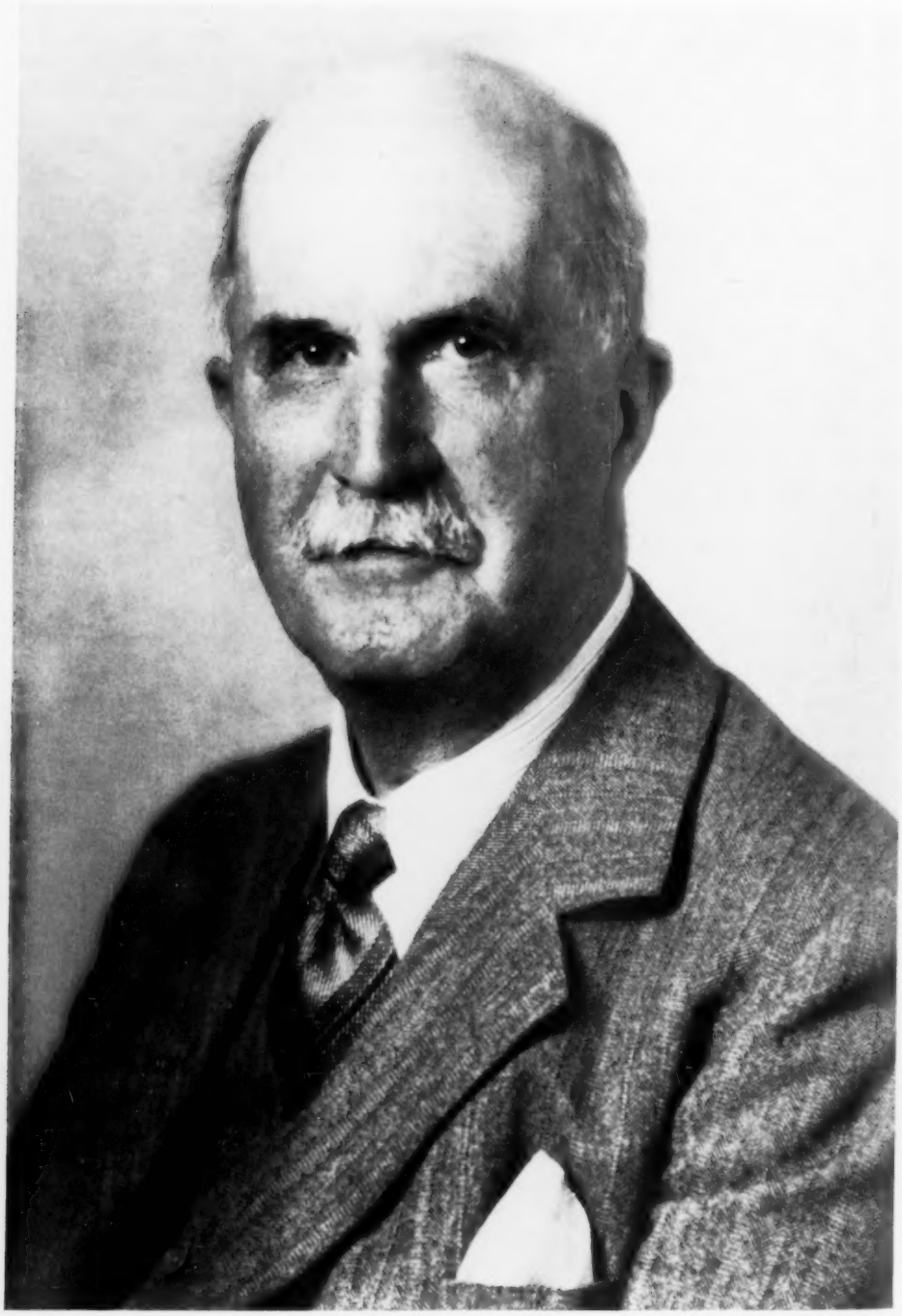
THE director of the Lighting Research Laboratory of the General Electric Company here presents his twenty-first book on light and lighting for laymen. It is a history of the development of lighting from ancient times to the most recent. Like all Dr. Luckiesh's books it is easy to read, full of wise comment and philosophy, and a superb exposition of modern practice. "Illuminating" would be the word for it, with the author himself a luminary of the first magnitude.

The first hundred pages are historical and social, the record of man's progress toward civilized living by coming indoors and into the glow of candles, lamps and matches. Another fifty pages are given to gas lights, electric arcs and glowing filaments—the era just closed or closing. The last 120 pages are the exciting story of to-day's innovations which are as yet not appreciated by the public, certainly not as the beginning of a new era of civilized living. These seven chapters discuss luminous vapors, fluorescent light sources, lighthouses and beacons, the art of lighting and illumination and artificial sunlight.

The theme of the book, as of the whole world of research from which it springs, is that the conquest of darkness is easy nowadays, but is not enough. The true purpose of artificial light is to compete with daylight, to challenge the sun itself.

GERALD WENDT

[1] *Torch of Civilization.* Matthew Luckiesh. xvi + 269 pp. $3.00. 1940. G. P. Putnam's Sons.



—*Underwood & Underwood*

SIR WILLIAM BRAGG

THE PROGRESS OF SCIENCE

SIR WILLIAM BRAGG

THE last two or three years have dealt heavily with those outstanding figures of science whose names will be forever linked with the greatest period of transition in the whole history of knowledge. Speaking only of those of English lineage we have, first, Lord Rutherford; then his old professor, Sir J. J. Thomson; next the oldest of them all, Sir Oliver Lodge; and now the Reaper of the Ages has gathered Sir William Bragg to the halls of the illustrious dead.

There are times in the progress of science when, mystified by a galaxy of discoveries which seem to change the face of nature, the student of philosophy feels anew the urge to believe that at last the secret of the universe has become unveiled and that the time has come to write a constitution thereof which shall be a perpetual guide to the thinking of mankind. The great discoveries of Faraday, Henry, Maxwell, Lorentz and Kelvin had promised well to supply the missing bricks to complete that great cathedral of knowledge whose foundations were laid by Newton and Galileo. So profound was the respect for this edifice, which seemingly was so near completion, that any novice in the workshops of the architects, who dared to add designs which were in any way out of harmony with the structure so far envisaged, was apt to be subjected to the paternal frowns of many great men who had earned the right to frown, and to be intimidated into an inferiority complex.

However, progress is no respecter of the might of the past, and the turn of the new century was to see many new things which staggered the imagination of even the radicals in the physics of the day. It fell to the lot of Bragg to become involved early in his scientific career in some of the most startling of those discoveries in x-rays which refused to fit in to the all but universally accepted order of things. Bragg felt keenly the necessity of invoking a new concept as to the nature of x-rays, a concept apparently completely out of harmony with the classical views. C. G. Barkla was the warrior who championed the old cause; and for many months *Nature* presented in each issue some new argument by one of the advocates as to why one view was right and the other was wrong. This discussion did much to clarify the picture and helped in the final consolidation of our views to a stage in which it was possible to consider that neither view was absolutely right and neither absolutely wrong.

In a less spectacular realm, Bragg contributed much to the then new science of radioactivity, but his x-ray researches were destined to find a new development and a new richness when x-ray spectroscopy was born. A cynic of the period might have found much to whet his sarcasm in contemplating the poetic justice of the situation in which Bragg was to find in the waves which he had fought so strenuously slaves who turned the other cheek to his assaults and combined by their services to contribute perhaps the greatest laurels of his career. In this very service, however, these waves and their rivals, the particles, found new bases of harmonization which ultimately approached logical form in the modern wave-mechanical theory.

Much of the work in x-ray spectroscopy was done by Sir William Bragg in close collaboration with his son, William Lawrence Bragg, now Lord Rutherford's successor at the Cavendish Laboratory, and by the combined efforts of father and son a new attack upon the structure of molecules and groups of molecules was developed to the stage of power and usefulness.

William Henry Bragg was born on July 2, 1862, at Wighton, Cumberland, England. After attending King William's College in the Isle of Man, he went to Trinity College, Cambridge. In 1886 he was appointed professor of mathematics and physics at Adelaide, South Australia, and in 1909 he returned to England as professor of physics at the University of Leeds. He was appointed Quain professor of physics in the University of London in 1915, and in 1923 he became Fullerian professor of chemistry at the Royal Institution and director of the Davy-Faraday Research Laboratory. During the First World War he acted in an advisory capacity to the British Admiralty and was created K.B.E. in 1920. Up to his death during the present war, he was again engaged in the services of the government. Sir William Bragg received the Nobel Prize in conjunction with his son in 1915. He received many honors, among them the Order of Merit, the Barnard Medal, Columbia University, and the Franklin Medal of the Franklin Institute. He served as president of the British Association for the Advancement of Science and as president of the Royal Society of London.

Sir William was noted for the clarity of his lectures and of his writings; and he has done good service for the layman in being responsible for two books of a popular nature entitled: "The Universe of Light" and "Concerning the Nature of Things."

Sir William Bragg married Gwendoline, the daughter of Sir Charles Todd, in 1889. Lady Bragg died in 1929, preceding by thirteen years her husband, who died at the age of 79.

Sir William was noted for his kindly disposition and his courtesy to all. He was one of the best loved and respected of the world's men of science, and his death has brought sadness to many a heart.

W. F. G. Swann

Bartol Research Foundation of
The Franklin Institute,
Swarthmore, Pa.

AFRICAN PLAINS EXHIBIT OF THE NEW YORK ZOOLOGICAL PARK

Although the Zoological Park in New York has long been renowned for the extraordinary variety and unique character of its animal collections, it has been no secret that some of the physical methods of exhibiting these great collections have left a good deal to be desired.

During 1939, when a modernization program was first decided upon, consideration was of course first given to the methods to be employed. Two general principles were adopted. First, that the moated or barless enclosure should be used to the greatest extent possible. Second, that much emphasis should be placed on showing groups of animals in free areas according to their continental habitats rather than by orders and families. It was believed, in other words, that the public would gain a far clearer conception regarding animal life were the collections exhibited in so far as possible in their natural environment and, further, grouped together as in nature in order to indicate the social interrelationships of various species. The advantage to the animals themselves was apparent.

While the new African Continental Exhibit represents a definite step forward in the art of exhibiting wild animals, recognition must be given to the excellent techniques developed by other zoological parks, both here and abroad, in the use of barless and moated areas and of naturalistic backgrounds. We are greatly indebted to the managements of some of the other larger zoos in this country for the collaboration extended to us in the preparation of our plans.

We determined to provide the public with as much information as possible

LOOKING ACROSS THE AFRICAN PLAINS AT THE BRONX ZOO
TOWARD THE LION SHELTER HOUSE. THE WATER HOLE IS IN THE CENTER.

regarding what might be termed the background, the story, let us call it, of the animal itself, of its derivation, even of its evolution. Consequently, at the entrance to "Africa," four large diagrammatic maps have been placed which present the remarkable development of life-forms, as they are known to have occurred in the Age of Reptiles, subsequently in the Age of Mammals, then in the Post-glacial era and finally the animal life of to-day. The last-mentioned map suggests as well some of the topographical and climatic characteristics of the continent. Although we are not as yet satisfied with the technique employed in this presentation it is at least a start in the right direction and has aroused wide public interest.

In the early stages of planning, it was recalled, further, that a naturalist in Africa occasionally observed grazing animals and carnivores in the same scene—a plains area in the foreground on which could be seen various kinds of antelope, zebra and other herbivores and on a rise of ground in the distance, a group of lions, sunning themselves perhaps, as if a temporary understanding existed between prey and hunter. This recollection provided us with the clue for the first two units of the African Continent Exhibit which have now been completed.

As one enters there lies before one an open area on which animals, roaming freely together, include zebra and various types of antelope, such as nyalas, impalas, elands, springboks, reedbucks, waterbucks and others. Scattered about, moving here and there, is a wealth of bird-life, including the following species: the ground hornbill, marabou stork, ostrich, secretary bird, griffon vulture, crowned cranes, demoiselle cranes and Stanley cranes. Beyond this foreground scene are the lions. The large moat between is so cleverly concealed that it appears at first sight as if all the animals including the so-called "king" are living together under a mysterious truce.

Samuel Gottscho

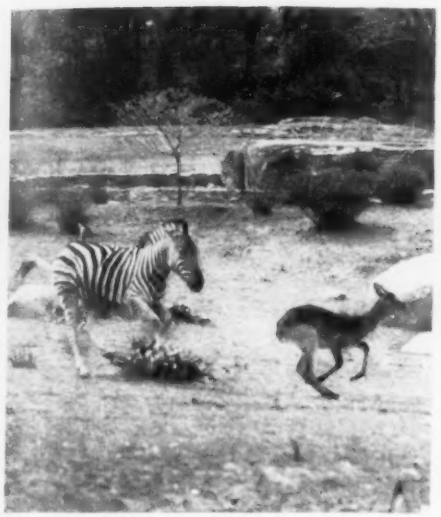
THE AFRICAN PLAINS AT THE BRONX ZOO

IN THE BACKGROUND, TOWARD THE TREES, IS THE SECTION THAT LATER IS TO BE DEVELOPED INTO MOATED ENCLOSURES FOR ELEPHANTS, GIRAFFES, HIPPOPOTAMUS AND RHINOCEROS.

Samuel Gottscho

FIVE YOUNG LIONS AT LIBERTY ON THE LION ISLAND UNIT

A MOAT TWENTY FEET WIDE SEPARATES THE LIONS FROM THE PUBLIC WALK AND THE REMAINDER OF THE AFRICAN PLAINS, WHERE ANTELOPES ARE AT LIBERTY.



A ZEBRA ON THE AFRICAN PLAINS

AT THE BRONX ZOO. THE TWO ZEBRAS THERE WERE EXTREMELY UNRULY FOR THE FIRST FEW DAYS AND CHASED MOST OF THE OTHER ANIMALS. IN LESS THAN A WEEK, HOWEVER, THEY SETTLED DOWN AND CAUSED FEW DISTURBANCES. ALL THE MAMMALS AND BIRDS FLED FROM THEM EXCEPT A PAIR OF STANLEY CRANES, WHICH BUILT A NEST AT ONE SIDE OF THE PLAINS; THE MALE CRANE, GUARDING THE NEST, FRIGHTENED THE ZEBRAS AWAY.

In general, the grouping of animals in the plains area has been successful, in so far as avoidance of accidents is concerned. Perhaps the most curious incident that happened was the fact that the lions, when first placed in their area, frequently jumped down into the moat, a drop of a sheer sixteen feet, with rough ground and broken stones at the bottom. Again it was proved how difficult it was to hurt a "cat," as none of the lions was injured. Finally their curiosity has been satisfied and they have stopped acting upon this exploratory impulse.

We are looking forward to the time when the African Exhibit may be completed. Plans have been drawn for areas for the elephant, giraffe, the primates, the rhinoceros and other major mammalian types. Eventually the public may come and see the panorama of this continent, so remarkable for the richness and variety of its animal forms. It is believed that this method of exhibition is not only interesting and beautiful, but rich, as well, in its educational values.

FAIRFIELD OSBORN

RECENT MOGOLLON DISCOVERIES

FIELD MUSEUM Archeological Expedition to the Southwest has just returned from New Mexico. The excavations were carried on in an ancient village which was occupied by people belonging to what we call the Mogollon ("muggy own") civilization. This culture has only been recognized a few years.

Approximately 600 stone and bone tools and 18,000 potsherds (broken pottery) were brought to light. These stone and bone tools are of an early type; the broken pottery is crude and undecorated. These rare specimens, together with the facts gleaned during the digging season, will be studied, correlated and reported on within the next five or six months. In the meantime, it is possible to make a few general statements and to sketch hastily the meaning of the summer's work.

Was the expedition a success? Emphatically, yes, it was. Did we bring back any showy specimens? No, we did not.

Archeology is not a search for specimens, anyhow; and emphasis on them indicates a lack of perspective of what it is all about. Archeology is, rather, a discipline dealing with man's history. We try to recover and interpret man's past; and in order to carry out this purpose we excavate. In digging a ruin in the Southwest, one finds tools of stone and bone, and generally pottery and houses. These tangible remains of the culture form the basis for reconstructing man's past—and therefore specimens are useful. It should always be remembered that probably 90 per cent. of the civilization dies when a village or town is de-

serted; for, from the dust, the archeologist can not recover the language spoken by the villagers, the dress, the social customs, the thousand and one items that make up any civilization. We can, however, by careful study and observation make guesses about the past.

Why was the Mogollon civilization and, in particular, the SU site chosen for study?

We are interested in studying the Mogollon civilization for many reasons. It represents an early stage in the development and growth of towns situated in fertile agricultural areas. The U. S. government is interested to-day in persuading isolated farmers to gather in central clusters or towns. Here, our modern farmers would have better social, psychological, educational environments. But to know whether such an experiment would be successful to-day, one has to study the past.

—*Field Museum of Natural History*

EXCAVATION OF PITHOUSE

Final plan view looking approximately east, with entrance cleared, except for a section of fill within the roots of the great juniper tree on the upper left. *Note:* the double line of small post-holes in the southwest quadrant; the squared break in the circle of the big northwest sub-pit, intentionally made to test the sterile layer at ancient excavated floor level (this break was not original); the bed of gravelly hard pan which runs from the west edge out into the center of the pithouse.

We are also interested in the religious, social and economic structures which the Mogollon Indians developed long ago; for an understanding of these fundamentals would help us understand man's eternal urge for progress and striving upward.

Furthermore—and this is what so closely links the present with the past and gives one a warm, comfortable feeling that one is not an isolated phenomenon on this globe without antecedents or successors—we are interested in showing that in spite of differences in time, climate, race and geography, men possess certain fundamental urges which cause them to act more or less similarly at all times and in all places. Thus we can easily see a sameness of development throughout all civilizations.

Therefore, our reasons for digging at the SU site are clear. We wished to learn how these primitive folk lived, how they grouped themselves socially, how they solved their economic, agricultural and religious problems, and why and how they lived in clusters of houses or villages. We desire this information because we must understand past and present man if we are to understand our civilization and help it improve.

The expedition gathered much information, some of which will be useful for helping to solve some of the problems outlined above.

What Was the Mogollon Civilization?

Up to a few years ago, archeologists believed that there was but one civilization in the Southwest and that it produced all the various types of pottery, houses and tools that we dug up. We

MEN EXCAVATING ANOTHER PITHOUSE WITH THE HELP OF HORSES

now know that this notion was incorrect. Within the last few years archeologists have demonstrated that there were two other civilizations which left their mark on the Southwest. The most recently discovered one is the Mogollon civilization, towards the discovery of which the Field Museum expeditions have greatly contributed.

What was the Mogollon civilization like, and what were its chief characteristics? The Mogollon civilization was a comparatively poor one. The people of this culture lived in pithouses—which were nothing more or less than big holes in the ground and which were roofed with logs, twigs, bark and earth.

We also discovered that in addition to pithouses, these Mogollon Indians built and occupied houses, the floors of which were *not* sunk into the ground. The walls of these houses consisted of upright poles set eight to fourteen inches apart. In between these poles, mud and small sticks were placed, thus forming a good tight wall. This kind of construction is called wattle-and-daub and contrasts with the below-ground houses found on a previous expedition.

Firepits were not found in any of the houses. Therefore, we believe that these Indians rarely used fire inside the house for cooking, warmth or light. Extensive digging outside the houses likewise failed to bring to light any firepits. But large deep pits were discovered and perhaps in these barbecuing was done. Or perhaps these people did little or no cooking.

Most of the houses were equipped with large or small entrance-tunnels which always faced east. Why these tunnels faced east is not known, although probably the orientation was for religious reasons. Entrance or exit from these houses was by means of these tunnels.

Life in the underground houses must have been somewhat dark and perhaps damp and not very comfortable. Next year we expect to reconstruct a roof over one of the old pits, let it stand for several weeks, and then burn it. In this way, we shall be able to answer some of these puzzling questions.

The stone and bone tools of the Mogollon Indians were crude and unlike those which one ordinarily associates with Indians. In fact, the stone tools—

A PARTIALLY STRIPPED PITHOUSE

looking approximately southwest. The apparent wall is actually humus-fill left in place during the operation of stripping, over the vertical face excavated into sterile ground by the original inhabitants. *Note:* pits and post-holes without the original excavated area of the pithouse, in the east and northeast; trace of refilled Pithouse E to north-northeast.

such as scrapers, choppers, hammerstones, polishing stones and pestles—are so primitive that one would probably pass them by without recognizing that they had ever been used by human beings for any purpose whatsoever. But, finding many such stones in all the houses caused us to note that they fell into distinct patterns and types and therefore could not be natural, unused stones.

It is interesting to note that no axes of any kind were found. The absence of this important tool makes us wonder how these ancient Mogollon people felled their trees, for we know that they used fair-sized trees for roofing their houses.

PLAN VIEW OF A PITHOUSE

LOOKING APPROXIMATELY NORTH AS ARROW AND METER STICK ARE BEING PLACED.

Burials

The dead were always buried in pits, which lay outside the houses or were dug in the house floors. The corpse was wrapped in a sitting or doubled-up position and was then placed in a pit. Generally, burials were not placed in house pits until after the house had been abandoned. But in some instances, the family continued to live in the house after a burial (family member?) had been placed in a floor pit. Of course the burial was covered with earth and the floor sealed the whole thing up. Offerings to the dead were very rare. The only objects found with skeletons were tobacco pipes and sometimes shell bracelets and necklaces. Whole pottery was never found, which may be an indication that pottery had only recently been adopted by this civilization and was therefore not yet really part and parcel of it.

The human skeletons themselves were in a very poor state of preservation, while animal bones found in the same excavation level were sound and well preserved. This may indicate that the animals obtained a better-balanced diet than the Indians of that period.

Food

During the season, only a few projectile points (arrow- and spear-heads) were found. On the other hand, many food-grinding tools were brought to light in great abundance from all

houses. It is assumed, therefore, that the Mogollon Indians of the SU village lived mostly on berries, roots, herbs and grasses, and depended very little on hunting or agriculture. This may also be a sign that this civilization is ancient, as the people were mostly seed-gatherers rather than farmers.

Age of SU Ruin

The age of the houses, pottery and stone tools which Field Museum Expedition discovered at the SU village in New Mexico is difficult to determine. Dating the SU village by means of tree-rings has thus far been impossible because the rings do not fit into any known sequence.

Some light on this question can be obtained by means of cross dating or comparison of the Field Museum tools with those from other ruins.

It is known, for example, that the SU ruin is earlier than A.D. 700 because no painted decorated pottery was recovered during the season. Painted pottery occurred in that area after A.D. 700.

Conversely, although the SU village stone tools are similar to those found (in southern Arizona by Gila Pueblo) in the San Pedro time period which dates at about 3,000 B.C. to 500 B.C., yet the SU village must date *after* that period because the SU villagers made pottery while the San Pedro people did not.

Therefore, the Field Museum village was founded and occupied some time between 500 B.C. and A.D. 700.

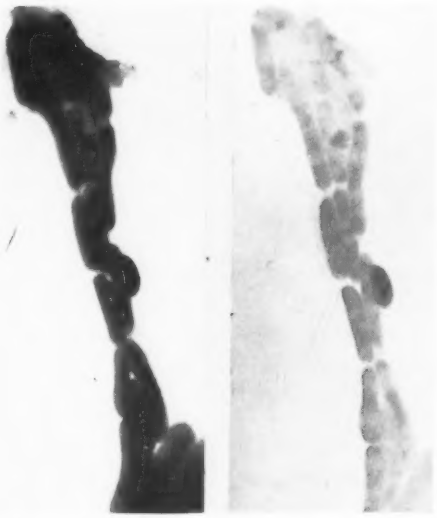
Probably the pottery which we found is among the oldest in North America.

Paul S. Martin
Field Museum of Natural History

THE NEW HIGH-VOLTAGE ELECTRON MICROSCOPE

In earlier issues[1] of this journal the remarkable properties of the electron microscope have been described and photographs taken with it have been reproduced. It has a very much higher resolving power than any ordinary microscope that has been made or can be made, for the limit to the resolving power of a microscope is half the wavelength of light, or about one hundred thousandths of an inch for the visible spectrum. The electron microscope owes its higher resolving power to the fact that it uses electrons instead of light for forming images. Its resolving power is of the order of two ten millionths of an inch, or its magnifying power is about fifty times that of the ordinary microscope.

The ordinary microscope owes much of its usefulness, especially in biology, to the fact that many specimens are partly transparent and consequently show their interior structure to a considerable extent. The electron microscope has not heretofore had this advantage because the



THROUGH AN ELECTRON MICROSCOPE
TWO PHOTOGRAPHS OF BACILLUS MEGATHERIUM MAGNIFIED 5,000 TIMES. *Left:* PHOTOGRAPHED WITH 50 KILOVOLT ELECTRONS. *Right:* PHOTOGRAPHED WITH 200 KILOVOLT ELECTRONS.

[1] T. A. Smith, 52: 337–341, April, 1941; J. A. Becker and A. J. Ahearn, 53: 309–324, October, 1941.

electron emissions have been nearly all from the surfaces of the objects under examination. In other words, they have behaved like opaque objects and the photographs have been in the nature of silhouettes.

Dr. V. K. Zworykin and his associates, Drs. J. Hillier and A. W. Vance, have recently announced an electron microscope that in a sense has penetration corresponding to that in the ordinary microscope. Heretofore electron microscopes have used electrons accelerated by from thirty to one hundred kilovolts. At these velocities the penetration of the electrons in organic materials is not more than about two hundred thousandths of an inch and less than a tenth of that amount in heavy metals. But by increasing the acceleration of the electrons from fifty to two hundred kilovolts, the penetration is increased to such an extent that the electron microscope has the advantages of the ordinary microscope in addition to its much greater magnifying power.

It is not to be assumed, however, that the new electron microscope will succeed those now in use. In the first place, for many purposes the additional penetration appears to give no new information. In the second place, to use the higher voltages adds to the bulk of the apparatus, greatly increases its cost and it is more difficult to operate. But for certain special purposes it will be very advantageous. F. R. M.

WARTIME PROGRAM OF THE NATIONAL GEOGRAPHIC SOCIETY

War conditions have made it necessary to curtail somewhat the scope of the joint expedition of the National Geographic Society and the Smithsonian Institution, planned for southern Mexico under the leadership of Matthew W. Stirling. For three winters Mr. Stirling has conducted the archeological studies in the State of Vera Cruz and adjacent states. This winter a smaller party under Phillip Drucker is in the field at La Venta, State of Tabasco, completing stratigraphic work which was carried forward in former years. La Venta is the site at which the expedition uncovered in 1940 five colossal sculptures in basalt of human heads, as well as massive stone altars decorated in high relief. These sculptures are attributed to the little-known Olmecs. Mr. Drucker will seek to uncover, largely through the study of pottery and figurines, additional information in regard to this people.

Studies of the Aurora that have been in progress for several years under the auspices of the National Geographic Society and Cornell University under the leadership of Dr. Carl W. Gartlein are being continued from observation posts that have been established at Cornell University, Ithaca, N. Y.; Colgate University, Hamilton, N. Y.; and Hobart College, Geneva, N. Y. Hundreds of photographs of auroral displays of numerous types have been made, many of them at the same instant from the several observation points. While making additional photographs of auroral displays that occur, Dr. Gartlein and his assistants will place emphasis on the analysis of selected photographs already made for the determination of the heights of Auroras. Another project will involve the possible correlations between auroral phenomena and magnetic and radio phenomena. J. K.